Threemile Restoration and Resiliency Project

Forest Vegetation Report

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September 11, 2018

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Introduction

This analysis summarizes the affected environment and environmental consequences to the forest vegetation and considers the effects of a No Action Alternative and two action alternatives (Alternative A and Alternative B) across approximately 12,137 forested acres within the project area. Alternative A proposes treatment on approximately 4,759 forested acres and Alternative B on 4,493 forested acres. An additional 240 acres under both alternatives will be reforested (planting of ponderosa pine). Proposed treatment includes commercial tractor logging (a mix of thinning densities, tree clumps, and small openings), post-sale noncommercial thinning treatments, pile burning, and broadcast burning. Treatments are proposed to meet the purpose and need for action, which includes: 1) Restore ponderosa pine ecosystems towards a more heterogeneous forested landscape with a diverse age and size structure (including old growth), understory structurers and composition, patch size, and pattern that are resilient to natural disturbances (e.g. fire, insect/disease, climate change, 2) promote ponderosa pine, 3) make progress changing the fire regime from low frequency high intensity towards one of higher frequency and lower intensity, 4) lessen the potential spatial extent and intensity of disturbances (such as high intensity wildfire and high mortality form beetles), 4) reduce fuel loads to enhance fire suppression capability by modifying fire behavior, 5) provide wood products to contribute to employment and industry in local communities and help support the sustainable supply of timber from National Forest System lands.

Issues

During project development, internal and external discussions revealed issues and concerns relating to forest vegetation. Issues were identified due to conditions resulting from past large wildfires on the district and within the project area. Large fires have reduced forest cover within the project area (northern portion). These areas are slowly reestablishing where there is a seed source and not reforesting where there is no available seed source. A concern is that another large disturbance could reduce forest cover even further in the southern portion. The southern portion of the project area has a more contiguous block of forest cover and is the focus of the proposed action treatments. A desired condition is to create structures in the southern portion that are more resilient to large disturbances that will limit large areas void of forest cover as seen in the northern part of the project area. Another desired condition is to reestablish forest cover in portions of the past wildfire areas in the northern portion of the project area that is lacking a seed source. These concerns and issues helped frame this forest vegetation analysis and include:

- Effects on overall fire and beetle hazard in conifers by reducing extent of high tree densities, high canopy cover, multi-story canopies and creation of a new age class of ponderosa pine. Effects on beetle hazard will be analyzed in this report and effects of fire hazard will be analyzed in the fuels report.
    - Effects on forest insect hazards, primarily mountain pine beetle (*Dendroctonus ponderosae)* and the pine engraver beetle (*Ips. spp).*
    - Effects of the alternatives on forest diversity in regards to 1) composition (tree size and age); and 2) horizontal and vertical structure (canopy cover, canopy layering and basal area).
- Consider the use of individual tree, clumps and opening methods (ICO) to meet the purpose and need (Churchill et al 2017, Clyatt et al, 2015, Reynolds et al, 2013, Churchill et al, 2013, Churchill et al, 2012, and North et al 2009).
- Promoting large tree development in the project area.
- Establishment of ponderosa pine in fire areas where seed source is lacking.

Resource Indicators and Measures

Four measurement indicators were identified to address the issues and concerns identified for forest vegetation (forest vegetation beetle hazard, composition and structure, and planting). These were chosen because they are measurable (qualitatively and/or quantitatively), affected by silvicultural activities, and related to the purpose and need. Measurement indicators carried forward in this analysis will be a combination of qualitative and quantitative, including:

- Forest Vegetation Composition - This indicator will discuss the effects of the alternatives on size class and age class. Measurement will be on discussion of change by classes pretreatment (2017), post treatment (2021) and 2041.
- Forest Vegetation Structure – This indicator will discuss the effects of the alternatives on horizontal structure (basal area per acre and canopy cover) and vertical structure (canopy layers). Measurement will be a discussion on change on these attributes pretreatment (2017), post treatment (2021) and 2041.
- Forest Beetle Hazard – This indicator will discuss the effects of the alternatives on pine beetle potential hazards. Measurement for comparison purposes will be by the percent change from pretreatment (2017), post treatment (2021) and 2041.
- Planting in old fire areas – This indicator will discuss the effects of the alternatives on artificial regeneration of forest cover in old wildfire areas. Measurement will be by acres planted.

Table 1: Resource Indicators and Measures for Assessing Effects

Resource Element	Resource Indicator	Measure (Quantify if possible)	Used to address: P/N, or issue?	Source (LRMP S/G; law or policy, BMPs, etc.)?
Forest Vegetation	Forest Vegetation Composition - Size Class and Age	Discussion of change from existing condition, post treatment and 20 years post treatment	P/N, issue	Internal, External Issues and Forest Plan
Forest Vegetation	Forest Vegetation Structure – Horizontal (Basal Area per acre and Canopy Cover) and Vertical (Canopy Layers)	Discussion of change from existing condition, post treatment and 20 years post treatment	P/N, issue	Internal, External Issues and Forest Plan
Forest Vegetation	Pine Beetle Hazard	Percent Change from existing condition, post treatment and 20 years post treatment	P/N, issue	Internal, External Issues and Forest Plan
Forest Vegetation	Planting	Acres planted	P/N, issue	Internal, External Issues and Forest Plan

Regulatory Framework

Forest Plan for the Custer National Forest

The Custer National Forest Land and Resource Management Plan (hereafter, Forest Plan) provides standards and guidelines for timber management (Forested Vegetation)

- Forest Plan Standards and Guidelines pertinent to Forest Vegetation–
    - Forest Wide Goals, objectives and standards

- Goal: harvest timber within sustained-yield capability to help maintain timber dependent communities, forest health, vigor, productivity, provide vegetative diversity for wildlife, eliminate tree encroachment on selected livestock grazing areas and provide scenic openings (USDA, 1987, pg. 4).
- Objective: provide an even flow of timber products to help support local industry, maintain a healthy diverse timber resource, improve or maintain wildlife habitat, and reduce natural fuel loading (USDA, 1987, pg. 5).
- Standards: Timber management activities will be designed and applied to maintain a variety of age classes. Size and shape of individual treatments units will be guided by characteristics of the stands and area and consideration of all resource s objectives. Size of openings created by even-aged silvicultural systems will normally not exceed 40 acres. Creation of larger openings will require public involvement and/or Regional Forester approval. Insect and disease infected timber will be managed in coordination with other resources. Strategies to treat and prevent insect and disease problem includ3e providing for age-class diversity, early slash cleanup, and stocking control (USDA, 1987, pg. 24).

- Forest Plan Monitoring Items.
  - E2 monitoring restocking within 5 years. Performed by post-harvest survival exams 1st, 3rd, and 5th growing seasons on all regeneration treatments after harvest is completed (REGEN ST and openings within CTM treatments) (USDA, 1987, pg. 107).
  - E4 assure Silvicultural management prescription are best suited to management area goals. Performed by presale and administration reviews with ID team involvement (USDA, 1987, pg. 107).

Management Areas

- Management Area B: Forested areas will be managed to perpetuate or enhance livestock forage and wildlife habitat values. May include removal of wood products, while protecting or enhancing range and wildlife resources. Contains lands suitable for timber production (USDA, 1987, pg. 46).
- Management Area D: Maintain long-term diversity and quality of habitat for selected species while accommodating other resource management activities such as timber harvest. Timber treatments that perpetuate or improve key wildlife habitat and livestock forage. Contains lands suitable for timber production (USDA, 1987, pg.54).
- Management Area G: Manage for the maintenance and improvement of a healthy diverse forest and as a source of wood products. Silvicultural systems will consider other resource needs such as wildlife habitat, visual impacts and livestock management. Silvicultural systems that favor natural regeneration will be favored (USDA, 1987, pg. 64-65).
- Management Area N: Provide healthy, self-perpetuating plant communities that will have optimum diversity of understory and over story vegetation. Timber harvest allowed

if woody draw wildlife habitat values can be improved or protected (USDA, 1987, pg. 84).

- Management Area P: Provide adequate facilities. Not part of timber base. Timber harvest for protection or maintenance of other values (USDA, 1987, pg. 88).

Regulatory Framework

There are eleven acts and a Code of Federal Regulations (CFR's) that give basic authority for silvicultural practices for forested vegetation on National Forest System lands.

- Organic Administration Act of 1897 (30 Stat. 34, as supplemented and amended; 16 U.S.C. 473-478).
- Knutson-Vandenberg Act of 1930 (46 Stat. 527, as amended; 16 U.S.C. 576-576b).
- Bankhead-Jones Farm Tenant Act of 1937 (50 Stat. 525, as amended; 7 U.S.C. 1010-1012).
- Anderson-Mansfield Reforestation and Revegetation Act of 1949 (63 Stat. 762; 16 U.S.C. 581j-581k).
- Granger-Thye Act of 1950 (64 Stat. 82, as amended; 16 U.S.C. 490).
- Multiple-Use Sustained-Yield Act of 1960 (P.L. 86-517, 74 Stat. 215; 16 U.S.C. 528-531).
- Supplemental National Forest Reforestation Fund Act of 1972 (87 Stat. 242, 245, as amended; 16 U.S.C. 576C-576e).
- Forest and Rangeland Renewable Resources Planning Act of 1974 (88 Stat. 476, as amended; 16 U.S.C. 1601-1610).
- National Forest Management Act of 1976 (90 Stat. 2949; 16 U.S.C. 1600 (note)).
- Reforestation Trust Fund, Title III - Reforestation, Recreation Boating Safety and Facilities Improvement Act of 1980 (16 U.S.C. 1606a, as amended).
- Title 36 Code of Federal Regulations, Part 219 - Planning.

All of these acts and CFR's direct the way the agency implements silvicultural practices. These guide us for the harvesting systems in accordance with regeneration requirements and timelines, a continuous supply of timber for the use and necessities for citizens of the United States, allowable collections from purchasers to carry out post-sale work, land conservation, land utilization, timber suitability determination, and multiple use and sustained yield of our National Forest resources.

Methodology

The interdisciplinary process for the Threemile project initiated with proposed treatment polygons from a previous analysis done prior to 2000. Due to the age of this analysis and changed conditions the forest vegetation data sets could not be used. Since that time Region 1 has developed an vegetation classification system (Bush, et al, 2010) and mapping product (R1-VMap) that utilizes various vegetation classification attributes that comprise mappable features (Barber, et al, 2011). VMap for the Ashland Ranger district was last updated by satellite imagery in 2013. Of interest for this analysis is the features of aspect, tree lifeform, size, and crown cover documented in the VMap map product. Size and crown cover are attributed into standardized class ranges and these classes are utilized for this analysis (Table 2).

Due to the large project area, a sampling design for the existing forest vegetation analysis was created using the VMap product as a base to randomly sample the existing condition. The proposed treatment polygons were overlaid with the VMap coverage. A 5 digit stratum label was created based on the various VMap attribute combinations occurring in the proposed treatment units (Table 2). The five digit stratum label consists of 3 attributes; aspect, dominant size class and dominant canopy cover class percent of the existing forested area within the treatment polygon. These attributes were assessed in the listed

order and assigned a 5 digit label according the specifics in the table below. Every stand that had existing ponderosa pine forest cover was assigned a strata code.

Table 2: Defined Strata Fields Used For Sampling the Existing Forest Vegetation (Ponderosa Pine)

	5 Digit Strata Code				
		Size Class		Canopy Cover	
Strata Attribute Codes	**Field 1**	**Field 2**	**Field 3**	**Field 4**	**Field 5**
Aspect: Moist (M) = N, NW, NE, E; Dry (D) = SE, S, SW, W.	When >50% of the forested area within treatment polygon is moist aspects assign M; or >50% dry aspects assign D.				
VMap Size Classes: 1 = 5 – 9", 2 = 10 – 14.9", 3 = 15"+, 4 = 0-4.9"		Assign a size class code (1, 2, 3, or 4) to the dominant size class (≥25% of forested area within treatment polygon).	Assign the second most dominant size class (1, 2, 3, or 4) that is ≥25% of the forested area within treatment polygon. **If ≥25% is not met assign a code of 0 (numeric).**		
VMap Canopy Cover Classes: a = 10-25%, b = 26-40%, c = 41-60%, d = 60%+				Assign a canopy cover class code (a, b, c, or d) to the dominant canopy class (≥25% of forested area with in treatment polygon).	Assign the second most dominant canopy cover class (a, b, c, or d) that is ≥25% of the forested area within treatment polygon. **If ≥25% is not met assign a code of 0 (numeric).**

A classification system was necessary to stratify the various VMAP vegetation attributes in order to randomly select stands to field sample for the project analysis. Strata was assigned into groups based on similar attributes and anticipated effects to disturbances. This process and the selection of stands per stratum group is documented in the project record (Sandbak, 2018A and Sandbak, 2018B). Sixty four stands where sampled across 28 strata groups during 2017 on 1,074 forested acres (Sandbak, 2018B). The data was summarized into attributes of interest for this analysis by individual sampled stands and also by strata group for use in this analysis (Sandbak, 2018C, 2018D, 2018E, 2018E, 2018F, 2018G, 2018H, and 2018I).

Previously forested areas within the wildfire burned areas were not included as they currently are not detected as forested in the VMap coverage. For the analysis on these areas the reforestation assessment documented in the Ashland Post Fire Landscape Assessment was used (USDA, 2014).

Field reconnaissance of the treatment units was done by the silviculturist, wildlife biologist, timber, and fuels specialists assigned to this project that assisted in the development of the treatments, understanding the existing vegetation, and validation of the data.

Modeling efforts for the East Short Pines Restoration and Resiliency Project (ESP) (USDA, 2016A) and the target stand development for the Eastern Zone of the Custer Gallatin National Forest dry and moist ponderosa pine (USDA, 2016B) were used to assist in this analysis. The Forest Vegetation Simulator (FVS) was the growth and yield model used in these efforts. This model is used throughout the Forest Service to model stand dynamics for silvicultural prescriptions, over time. FVS also has the capabilities to calculate various stand attributes throughout the simulation. These modeling efforts were used because the stand conditions in ESP were very similar and the treatments modeled in ESP and the target stands are the same as what is proposed in the Threemile Project. These modeling efforts allowed analysis at pretreatment (2017), post treatment (2019) and in 2041 for the resource indicators and measures for assessing effects (Table 1). Analysis of the exiting forest vegetation was done at two different geographic levels: within the treatment areas and across the project area to get at direct, indirect and cumulative effects.

Assumptions

- Inventoried strata data was used for all treatments (Sandbak, 2018H and 2018I).
- For the action alternatives including the No Action for comparison purposes it is assumed no large disturbance events (insect, disease, wind or wildfire) will take place in the 24 year time period.
- For analysis purposes individual strata were assigned in groups according to similarities in attributes and anticipated effects (Sandbak, 2018G, 2018H, and 2018I). Effects are analyzed on the treatments using the strata summary data (Sandbak, 2018H and 2018I).
- Modeling efforts for the East Short Pines Restoration and Resiliency Project (USDA, 2016A) and the target stand development for the Eastern Zone of the Custer Gallatin National Forest dry and moist ponderosa pine (USDA, 2016B) were used to assist in this analysis. This allowed ability to show trends of existing forest vegetation structure, composition, and successional stage and beetle hazard against the proposed treatment types for the 3 time periods (2017, 2021, and 2041). Methodology by measure for this analysis is documented in the project record (USDA, 2018J).
- Forest vegetation activities were modeled according to desired conditions described in the Threemile Restoration and Resiliency Project Environmental Assessment and Scoping Document (Tables 1, 2, 3, 4, and 5 in the Environmetal Assessment and Table 1 in Scoping Document).
- Prescribed fire post commercial treatment purpose is for natural fuels activity reduction and to return fire as a process. Effects to the forest vegetation are minimal and therefore changes not detected in analysis (Table 14).
- FVS is a tree model; treatments in non-forest settings were not analyzed in this report.
- Approximately 4,759 forested treatment acres were analyzed in Alternative A and 4,493 acres for Alternative B (direct and indirect effects) for this analysis (Sandbak, 2018H and 2018I). For cumulative effects 12,137 acres were analyzed for the No Action and action alternatives (Sandbak, 2018H and 2018I).
- ICO and skip treatments (ICD, ICD clumps, CTM thinning, CTM clumps, CTM small openings, REGEN ST, and NO TREAT) where analyzed based on acres of individual treatments types (Sandbak, 2018H, Sandbak 2018I, and Tables 19 and 41).

For analysis purposes data was grouped into prescription groups that had similar primary vegetation management objectives that the interdisciplinary team developed to create changes in the existing forest vegetation and promote diversity by creating variable individual tree spacing, leaving clumps with interlocking crowns, creating small openings for a new age class and leaving untreated areas. The following table identifies the prescription group and the corresponding treatment types in the Threemile Restoration and Resiliency Project Environmental Assessment and Scoping Document (Tables 1, 2, 3, 4, and 5 in the Environmetal Assessment and Table 1 in Scoping Document) and highlights the primary management objective.

Table 3: Prescription Group by Treatment Type by Primary Vegetation Management Objective.

Prescription Group[1]	Treatment Code[2]	Primary Vegetation Management Objectives
1 - Commercial Harvest Improvement Treatment	ICD (dry sites): Individual tree thinning; over story (>9" dbh) and understory (< 9" dbh).	• Promote large widely spaced over story individual trees (variable spacing) very low canopy cover on dry sites. • Reduce ladder fuels. • Create single to two stories with lower stocking by thinning understory (<9" dbh thinned to 20 foot spacing and less than 100 TPA). • Increase resiliency to disturbances (MPB outbreaks and wildfire). • Provide wood products. • Promote old growth attributes where exist. • Whole tree log, pile and burn to reduce activity fuels.
	ICD (dry sites) with RXB PP (broadcast burning)	• Return fire as a process. • Reduce natural and activity fuels.
	Clumps (dry sites): Over story and understory.	• Promote clumps of large and small trees with interlocking crowns where available. • Reduce ladder fuels. • Create two story clumps by leaving tree clumps >9" plus clumps 5 to 9" with interlocking crowns. • Increase resiliency to wildfire. • Maintain large and small tree clump diversity.
2 – Commercial Harvest Thinning Treatment	CTM (Moist sites): Individual tree thinning; over story (>9" dbh) and understory (< 9" dbh).	• Promote large moderately spaced individual trees (variable spacing). • Create single to two stories with lower stocking by thinning understory (<9" dbh thinned to 20 foot spacing and less than 100 TPA). • Increase resiliency to disturbances (MPB outbreaks and wildfire). • Provide wood products. • Promote old growth attributes where exist. • Whole tree log, pile and burn to reduce activity fuels.
	CTM (moist sites) with RXB PP (broadcast burning)	• Return fire as a process. • Reduce natural and activity fuels.
	Clumps (moist sites): Over story and understory.	• Promote large and small trees with interlocking crowns where available. • Reduce ladder fuels. • Create two story clumps by leaving tree clumps >9" plus clumps 5 to 9" with interlocking crowns where available. • Increase resiliency to wildfire. • Maintain large and small tree clump diversity.
3 – Commercial Harvest Small Openings	CTM (moist sites): Small openings	• Initiation of a new age class of trees. • Promote patch size of ½ to 4 acres.

Prescription Group[1]	Treatment Code[2]	Primary Vegetation Management Objectives
		• Increase resiliency to disturbances (MPB outbreaks and wildfire). • Provide wood products. • Whole tree log, pile and burn to reduce activity fuels.
	CTM (moist sites) with RXB PP (broadcast burning)	• Return fire as a process. • Reduce natural and activity fuels. • Prepare seed bed for natural regeneration of ponderosa pine seedlings.
4 – Commercial Harvest Regeneration (Seed Tree) Treatment	REGEN ST (moist sites)	• Initiation of a new age class of trees. • Promote patch size up to 10 acres. • Increase resiliency to disturbances (MPB outbreaks and wildfire). • Provide wood products. • Whole tree log, pile and burn to reduce activity fuels.
	REGEN ST (moist sites) with RXB PP (broadcast burning)	• Return fire as a process. • Reduce natural and activity fuels. • Prepare seed bed for natural regeneration of ponderosa pine seedlings.
5 - Broadcast Burning	RXB PP – Prescribe fire ponderosa pine	• Reduction of fuel hazard (natural fuels: vertical ladder fuels and horizontal stocking). • Increase resiliency to disturbances (MPB outbreaks and wildfire). • Return fire as a process.
6 – Broadcast Burning for Non-Forest Restoration	RXB NF – Prescribe fire Non-forest	• Includes areas of >10% forest cover; these areas will have the same objectives as 6 above. • Enhancement and maintenance of non-forest vegetation for range forage productivity and diversity for wildlife/livestock.
7 – Commercial Woody Draw Treatment	WD – Woody draw restoration within ICD, CTM and REGEN ST.	• Maintain and promote green ash and woody draw vegetation on landscape. • Reduce competing ponderosa pine. • Retain 10% existing large ponderosa pine trees. • Increase resiliency to disturbances (MPB outbreaks and wildfire). • Provide wood products. • Whole tree log, pile and burn to reduce activity fuels.
8 - Planting	PLT – Artificial regeneration	• Initiation of a new age class of seedlings in wildfire areas lacking an adequate seed source to reforest timely. • Return forest cover for wildlife habitat.
9 - NT	NT – No treatment areas	• Maintain existing conditions (skips). • Retain single to multistory and low to high canopy cover. • Promote multistory, high canopy cover un-thinned areas.

[1]Primary forested prescription, activity and natural fuel treatments vary across treatments. [2]Non-forest treatments are discussed in fuels report and range report.

Incomplete and Unavailable Information

No incomplete or unavailable information pertinent to the forested vegetation analysis.

Affected Environment

Existing Condition

The project area encompasses 32,924 acres, of which about 12,137 acres are currently forested with ponderosa pine. The project area lies south of Highway 212 approximately 9 air miles east of Ashland, Montana. The southern half, currently has the largest extent of forest cover and where the majority of the proposed treatments would occur. The northern portion has experienced multiple large fires since 2000 and currently is in various stages of recovery. These fires have resulted in about 827 acres of non-forest conditions, that were previously forested and about 4,241 acres in a state of naturally reforesting. Proposed vegetation treatments are focused on the existing ponderosa pine forest cover, which this analysis will focus on (See Threemile Restoration and Resiliency Project Environmental Assessment Proposed Treatment Prescriptions (Tables 1, 2, 3, 4 and 5) and Scoping Document (Tables 1, 2, and 3). The ponderosa pine forested setting is the resource of concern and beetle hazard, vegetation composition, vegetation structure and planting are the issues pertaining to the purpose and need for restoring the pine ecosystems to a more heterogeneous landscape that are resilient to natural disturbances.

Small inclusions of woody draws containing deciduous trees (green ash and other deciduous species) occur on less than 1% (~90 ac) of the project area. As an opportunity for enhancement of the woody draws when encountered during commercial harvest operations (estimated between 1 and 2 acres), 90 percent of the ponderosa pine will be removed (see Threemile Restoration and Resiliency Project Environmental Assessment Table 1 Proposed Treatment Prescriptions – WD Woody Draw Treatment Activity or Table 1 in scoping document).

The analysis area for determining the direct, indirect, and cumulative effects for the ponderosa pine forested vegetation is the treatment units and the project area boundary.

The following section discusses the general existing condition of the forested vegetation in the project area for the issues and concerns that were identified above.

Fire and insects are the most common natural disturbances in the project area that have had or may have influence on the current condition of the forest vegetation. These disturbances are natural processes in forest vegetation landscapes and they can be large or small and occur on an individual tree basis. Wildfire has been the most recent significant disturbance process (~18,574 acres) that resulted in large amounts of mortality (Yeager, 2018B). Active fire suppression and wildfire has largely shaped the current forest conditions. Past vegetation management documented since 1983 has influenced portions of the current forest vegetation (Yeager, 2018A).

Fire

Fire disturbances provide us a record of its effects to forest vegetation through fire scars and forest conditions. Ages of the over story range from 40 to 234 in the project area (Table 6). Trees older than 180 are uncommon and widely scattered across the project area. There have been 19 fires documented in recent history in the project area across 18,574 acres (Yeager, 2018B). Most notably since 2000 there has been 3 fires that have totaled 18,110 acres. Some of the fires have overlapped, total footprint of documented wildfires is 11,188 acres. Fire effects from fires prior to 2014 are incorporated in the existing condition for the data set used. Four fires in 2014 and 2016 totaling 62 acres were included in the sample design for inventory and were generally low intensity fires. See the Fire and Fuels section for information related to documented wild fires within the project area.

Historically, frequent low-intensity fires cleared dry type ponderosa pine forest types of brush and grass but left trees alive and healthy (Graham, et. al, USDA 2004). Extreme fires were uncommon. By excluding fire from the natural cycle through decades of fire suppression, extended drought and other changes, the result is greater tree densities and a buildup of flammable vegetation across large areas of the forest landscape resulting in large stand replacement fire. The 1988 Brewer Fire (53,300 acres), 2002 Kraft Springs Fire (65,551 acres), and the 2012 Duggan Draw Fire (10,574 acres) that burned across multiple land ownerships are examples. As well as the fires discussed above in the project area.

Prior to Euro-Americans settlement, dry ponderosa pine forests, such as those in the Threemile project area, were burned by frequent low or mixed severity fires (Hessburg, Agee, Franklin, 2005, Brown, Sieg, 1996 and Sneed, 2005). These mostly surface fires maintained low and variable tree densities, light and patchy ground fuels, simplified forest structure, and favored a patchy cover of associated fire-tolerant shrubs and herbs (Hessburg, Agee, Franklin, 2005). Low severity fires maintained fire-resilient structures by elevating tree crown bases and scorching or consuming many seedlings, saplings, and pole-sized trees. Such fires cycled nutrients from branches and foliage to the soil, where they could be used by other plants, and promoted the growth and development of low and patchy understory shrub and herb vegetation. Finally, surface fires reduced the long-term threat of running crown fires by reducing the fuel bed and metering out individual tree and group torching, and they reduced competition for site resources (nutrients, light, and water) among surviving trees, shrubs and herbs. Rarely, dry forest landscapes were affected by more severe climate-driven events (Hessburg, Agee, Franklin, 2005).

Dry forests no longer appear or function as they once did. Changes in disturbance processes have resulted in large landscapes that are homogeneous in their compositions and structure, and these landscape are set up for severe, large fire and insect disturbance events (Hessburg, Agee, Franklin, 2005).

Small fires, if they had been allowed to burn in the early 20th century, or were intentionally lit, would have broken up the dry forest thereby reducing the size of the area influenced by uncontrolled wildfires that we are experiencing today. Changes that have occurred and the effects of those changes from wildfire suppression (management) have been discussed in the literature (Hessburg, Agee and Franklin, 2005). Table 4 compares key changes and their effect on the landscape.

Table 4: Key Changes in Dry Forest Landscapes

Change	Effect
Reduced grassland and shrub land area in forest potential vegetation settings and expanded forest area.	Increased homogeneity of the landscape vegetation and fuels mosaic.
Reduced old and new forest area.	Increased homogeneity of the landscape vegetation and fuels mosaic reduced spatial isolation of areas prone to high-severity fires.
Loss of grass and shrub understories. *	Reduced likelihood of low-severity fires with increasing flame length, fire line intensity, rate of spread, increased fuel ladders and likelihood of crown fire.
Increased tree canopy cover, and canopy layers. *	Increased fuel ladders, potential flame lengths, fire line intensity, rate of spread, and likelihood of crown fires.
Increased young multi-story forest area. *	Increased landscape homogeneity, reduced fire tolerance, increased fuel ladders, potential flame lengths, fire line intensity, rate of spread, and likelihood of crown fires.

*Indicates a strong correlation with severe fire behavior.

Changes in disturbances process have also been noted in the literature and include (Hessburg, Agge, Franklin, 2005):

1. Elevated fuel loadings and increased connectivity of high fuel loading;
2. Increased potential for running crowning fires;
3. Increased vulnerability to many insect and disease disturbances;
4. Increased likelihood of severe fire behavior in forest stands or patches with respect to flame length, rate of spread, and fire line intensity;
5. Increased contagion or spatial aggregation of vulnerability to severe fire and insect and disease disturbances.

There is little evidence that current patterns in dry forest today are sustainable and this has important ecological consequences (Hessburg, Agge, Franklin, 2005). The Threemile project area is increasing in homogeneity in its composition and structure, and the landscape is set up for severe, large fire and/or potential insect disturbance events. To date, wildland fires alone have not created ecological outcomes that are desired by society.

Not all fires are undesirable by society. The effects from severe and large wildfires are what some of society finds undesirable. These types of fire put a number of important values at risk as exemplified by the destruction of more than 3,600 homes in the wildfires that burned in southern California in 2003 (Graham, Jain, Matthews, 2004). Homes maybe the most recognized value at risk, but there are other values at risk including critical infrastructure (power grids, drinking water supplies), sensitive or protected fish and wildlife habitat, firefighter health and safety, public health and safety, soil productivity, aesthetics, clean air, and other important components of forest ecosystems (Graham, Jain, Matthews, 2004).

The Kraft Springs Fire in 2002 on the Custer National Forest resulted in the private sector sustaining a $2.5 million dollar impact to improvements, property and economic loss (Sandbak, 2003, Brewer Fire Revisited, slides 57-59). These types of impacts are not desired by the public and were voiced loudly during local public meetings during and after the Kraft Springs Fire (Sandbak, 2003, Brewer Fire Revisited, slide 60).

Fire resilience and sustainability of dry forest landscapes can be improved by thinning from below (reducing ladder fuels) and/or applying regeneration harvest systems (Graham and Mathews, 2010). Treatments should emphasize opening up the canopy to relatively wide spacing, reducing canopy layering and removal of the smaller size classes, coupled with prescribed burning and/or mechanical fuel treatment of the natural and activity surface fires. Many examples have been documented in the literature to support this.

Studies for evaluating effectiveness of pre-fire fuel treatments were done on the 2002, 2003 and 2004 large wildfires in the western United States (Omi, Martinson, Chong, 2006). In this study fuel treatment effectiveness was found to be dependent on the type of treatment. Treatments that included reduction of surface fuels were generally effective, with or without prior treatment of canopy fuels. Thinning followed by slash treatment produced the most impressive results. Thin-only treatments were generally ineffective and in some cases produced greater fire severity than adjacent untreated areas due to presence of elevated amounts of ground fuel.

In 2005, Strom also noted in her study that the combination of cutting and prescribed fire had the greatest effect in reducing wildfire burn severity. She noted that prescribed fire alone reduced burn severity, but only if it took place within 10 years of the wildfire.

Skinner, Ritchie, Hamilton, and Symons (2004) evaluated effects of thinning and prescribed fire on wildfire severity that they summarized for a 2002 wildfire. They reported there was a higher percent of mortality in untreated stands vs. treated stands. They noted that where ladder fuels had been treated but then those surface activity fuels were not treated, resulted in ineffective reduction in wildfire severity. However, when ladder and surface fuels had been sufficiently reduced, crown fire and severity of wildfire was reduced.

Cram, Baker and Boren (2006) studied 2002 and 2003 wildfires in New Mexico and Arizona and reviewed fire effects in silviculturally treated vs. untreated stands. They concluded similar results: the more aggressive the treatment the less susceptible forest stands were to crown fire and mechanical treatment followed by prescribed fire had the greatest impact toward mitigating fire severity (i.e., aerial and surface fuels were reduced).

Graham, Harvey, Jain, and Jonalea in 1999 indicated that the best general approach for managing wildfire damage seems to be managing tree density that includes a mix of thinning, surface fuel treatments, and prescribed fire.

Covington et al (1997) concluded from their initial ecosystem restoration work that the combination of thinning and burning changed forest structure to a fire behavior model where crown fires are common to a fuel behavior model where surface fires occur, but crown fires are highly improbable.

Fitzgerald in 2005 indicates that ponderosa pine forests today contain an overabundance of fuels and stand densities have increased. As a result, long-term stand, and landscape health has been compromised. Conditions now promote large, uncharacteristic wildfires. He concludes that restoration treatments such as thinning and prescribed fire that reduce surface, ladder and crown fuels can reduce fire severity and potential for high-intensity crown fires. Doing nothing he contends will result in forests that continue to deteriorate over time because wildfire today no longer operates in it historical fashion, that of frequent low-intensity surface fires. He further indicates to make a real difference at the landscape level it will require a suite of treatments (thinning, prescribed fire, and combinations).

This too has been demonstrated on the Sioux Ranger District of the CGNF. There are sale units in the Ward timber sale (1986-1988) and Pot Hole timber sale (late 1970's) in the Long Pines land unit that had harvest systems implemented similar to those in the ESP Proposed Action Alternative. From photos post Kraft Springs fire (2002), one can clearly see in the Pot Hole sale that the large stand replacement fire in 1988 (Brewer) and then again in 2002 (Kraft Springs) that the over story and the dense unthinned understory has remained relatively intact (Sandbak, Clark, 2005). The wildfire was a crown fire and when it came to the treated stand it became a surface fire and burned in a mosaic pattern within the treated area. Once through the treated stand the fire became a crown fire in the nearby-untreated area. This fire behavior was also demonstrated in the Ward Timber Sale with the 2002 fire.

Current research clearly indicates the potential of fuel treatments in reducing fire severity and thereby making treated stands more ecologically and functionally resilient than untreated stands.

Fire's role and projected role in the project area will be discussed in the fuels report.

Insects and Diseases

Forest insects and diseases are important disturbance agents within the project area. They can affect structure, composition and age class of the forest ecosystem at various scales. These effects can range from mortality of individual trees to large outbreaks that result in extensive mortality. Various insects and diseases are present in the project area. Endemic populations are always present, and have helped shape

the current forest condition and will continue to play a role at shaping vegetation conditions in the project area. No large outbreaks have been documented in the project area in recent history.

The most common insects and diseases that have been detected in the project area include mountain pine beetle, pine engraver beetle, tip moth, and western gall rust (scanned field inventories available in project record). None of these are currently at epidemic levels.

Mountain pine beetle has been identified in the project areas during the field inventories. Endemic levels have been operating in the project area at very low levels. Scattered individual trees or small groups of MPB mortality were detected, with only two recent attacks observed during field inventory. MPB is further discussed below.

Western gall rust is the most common rust found in ponderosa pine. Infections are found across the project areas. Trees of all ages are affected. Cankers on stems of seedlings and saplings are generally lethal. Stem cankers on larger trees are prone to stem breakage, especially in wind and snow events, as seen from recent storm damage where breakage occurred at the site of a stem canker

Management is best achieved by removal of infected or most severely infected (stem galls or more than 6 branch galls) individual trees (Hoffman and Hagle, 2011). Thinned stands with residual branch galls tend to become inactive within ten years due to increased vigor and growth and shading out of the lower infected branches (Hoffman and Hagle, 2011).

Pine engraver beetles are relatively non-aggressive beetles that take advantage of host material (ponderosa pine) available to adults emerging from overwintering sites. Colonizing such material in early spring often produces another generation of beetles that frequently attack and kill trees in mid-summer. Most of the pine engravers locally are *Ips pini*, but other associated species are common. Pine engraver beetle has been observed in the project area associated with wind damaged trees, occasional standing tree attacks have been noted. Stand conditions conducive to attack are the same as for mountain pine beetle.

Most pine engraver (*Ips, spp.*) problems are associated with disturbances such as wind throw and snow breakage, drought in spring and early summer, logging, fires, road construction, housing development or other human activities. Pine slash or weakened trees created by these disturbances attract beetles and provide ideal conditions for population buildup and subsequent tree killing.

Because pine engraver beetles overwinter as adults and normally only infest fresh slash when they emerge in the spring, activity slash created from early winter through late spring can be especially hazardous by providing large amounts of breeding material. Slash should not be created during this period unless it can be treated prior to beetle emergence. Creating slash from about January through July increases the likelihood of subsequent tree killing. When it is not practical to avoid creating slash during high-risk months, several management practices can be used to help minimize potential impacts, including:

- Prompt slash disposal,
- Lopping slash into smaller pieces making it less suitable for beetle colonization,
- Providing a continuous supply of fresh slash during flight periods to keep them out of standing green trees,
- Staying on established skid trails to avoid damage of residual stands, and
- Using pheromone-based funnel traps capture emerging beetles.

There has been five tip moths identified on the Ashland district, *Ryacionia fumosana, Ryacionia neomexicana, Ryacionia bushnelli, Ryacionia zozana and Ryacionia busckana.* Some of these tip moths

can have 2 to 4 plus generations per year. Damage in the project area is seen as generally light to very small areas of heavy damage. Heavy damage is seen in stands where understories are dense and over stories have a basal area greater than 60 square feet per acre. Damage is mainly confined to seedlings and saplings, but can be seen on the lower third of tree crowns in the upper canopy trees. Tip moths mine into terminal leaders and buds creating crooks, forks, multi-tops and reduced height growth. Mortality is uncommon. These deformities and reductions add to the vertical structure to the fuels complex.

Tip moths over-winter as pupae in the organic liter layer and soil. They emerge in May and June to lay their eggs on pine needles, buds and shoots. The larvae feed during June and July (Furniss and Carolin, 1977). Regular ground fires in these communities create a negative environment for the tip moth by affecting soil/organic liter layer conditions where the tip moth pupates (Bell, 1993). Bell noted from other studies that site preparation in the form of burning showed reduced tip moth populations. Vegetation control such as mechanical treatments and prescribed fire may result in a lack of habitat for tip moth predators and parasites and/or create a more favorable environment for tip moths by promoting more shoot growth.

Past Forest Vegetation Management

Management activities that have been documented in the project record on Forest Service Lands effecting the forested vegetation includes:

- Prescribed Burning – 1983, 1984, and 1988 across 294 acres. 2010 and 2012 across 2,334 acres. Recent burning created understory mortality from 40 to 80% across about 70 to 80% of the acreage. Over story mortality (direct and indirect) detected on VMap in these treatment areas indicates up to 83% mortality. Majority of the forested area experienced less than 20% over story mortality, with 16% showing 21 to 40%. Less than 3% indicated mortality greater than 40%.
- Commercial Harvest – 1989 on 235 acres. This was an intermediate harvest where the over story was removed and the understory was thinned.
- Non Commercial Thinning – 1989 on 235 acres. 2009, 2010 and 2011 on 4,270 acres. On the recent acreage fuels thinning was done on scattered small areas and bands along edges of burning units to reduce ladder fuels and/or create a fuel bed to assist in the implementation of the burn. In 2010, 342 of the thinning acres had mastication/chipping.
- Planting – 54 acres in 2012.

All of these activities occurred prior to the date of VMap imagery (2013) and the field sampling, effects of these activities to the forested vegetation are incorporated in the existing data set used in this analysis. Additional piling and rearrangement of activity fuels have occurred on the above activities across about 1,400 acres. Past wildfires since 1985 have occurred on 18,524 acres with some areas burning more than once (Yeager, 2018B). Total footprint is about 11,188 acres (Yeager, 2018B). All of these fires effects are incorporated by VMap or the field sampling.

Forest Vegetation Composition (Size Class and Age)

Often forests are seen through our eyes as static entities. An example is a stand of trees we have visited many times but continues to appear unaltered. This concept could be no farther from the truth. Change is constant in forest communities. Change occurs at all scales from a seedling sprouting, to a wildfire consuming tens of thousands of acres of trees. This change is multi-dimensional and also occurs at various time scales. Often the timescale of change within a forest is comparatively long, as some trees within the analysis area have existed at the same location and in similar form for a hundred years. At a

stand and landscape level, this change is often associated with disturbance factors (insects, disease, fire, wind, competition). These disturbances often result in the establishment of a new age class or cohort.

A successive change in vegetation following disturbances is referred to as succession. A seral stage is a temporal and intermediate stage in the process of succession. Tree size, successional development, and tree ages are generally considered to be correlated. This may not be true under all circumstances but it is generally accepted given the disturbance regimes and patterns of forest communities in the Northern Rockies. For this analysis, size class is used to display successional stages for the project area. See Table 5 for a general description of size class by successional stage.

The Forest Plan has a goal to provide for vegetative diversity for wildlife and maintain forest health, vigor and productivity. Promoting a variety of size classes (or successional stages) provides for vegetative diversity. This not only provides for a variety of successional stages for wildlife, but may reduce impacts to certain disturbances. An example would be smaller trees are less at risk to mountain pine beetle (MPB) attack; larger, dense trees are at a higher risk. A landscape dominated by a large size class that is dense may put a landscape at a higher risk for loss of many trees if an outbreak were to occur. A diversity of successional classes may allow natural disturbances (like MPB) to have less effect. See Table 5 for a general description of size class by successional stage. Ponderosa pine is the dominant species across all size classes.

Size Class. Table 5 indicates the predominant size class is 10-14.9" at 93.1% of the forested portion of the project area, followed by size class 5-9.9" at 5.4%, 15"+ at 1.4%, and .1-4.9" at 0.2%. The VMap classification detected no representation in the <.1" inch size class. The fire area in the northern portion of the project area has reforestation initiating on approximately 4,241 acres that was not detected. This acreage is currently not assessed as existing forest cover for this analysis.

Table 5: Size Class by General Successional Description

Size Class in Inches (diameter)	General Successional Description	Acres	% Forested Area
<.1"	Seedlings and new Regeneration <4.5' tall	0	0.0%
.1- 4.9"	Saplings ≥ 4.5' tall	21	0.2%
5 - 9.9"	Pole	653	5.4%
10- 14.9"	Mature/Over mature	11,296	93.1%
15"+	Mature/Over mature	167	1.4%
	Total	**12,137**	**100%**

Age. During sampling the dominant over story age class was found to be between 120 and 140 years old, which would indicate a large disturbance likely occurred in the late 1800's. Older ages as displayed in the table below indicates there were residual live trees post disturbance. Trees continued to establish post disturbance which resulted in the horizontal and vertical structures (canopy cover and canopy layer) we see today. Field sampling and reconnaissance indicates individual large trees > 17 inches and > 180 years are widely scattered throughout the project area. These typically have flat-tops, small live crowns, thinning crowns, thick fissured orange colored bark, stem rot, with many having old fire scars on the base of the tree bole. The oldest tree sampled was 234 years old. These older trees are generally found in small areas (less than 1 acre) and rarely exceed 3 per acre. The table below shows ages within the sampled strata.

Table 6: Sampled Ages by Strata Group and Size Class

	Sampled Ages by Strata Groups and Size Class					
Strata Group	**<.1" dbh**	**.1 - 4.9"**	**5- 9.9"**	**10-14.9"**	**15"+**	**Acres**
1	2 - 12	18	97 - 107	106 - 125	NS	228
2	8 - 10	15 - 68	52 - 122	78 - 132	82 - 188	342
3	10 - 16	16 - 40	34 - 90	44 - 120	87 - 130	1,056
4	NS	NS	100	85 - 164	74	95
5	2 - 15	11 - 42	21 - 120	46 - 154	89 - 210	1,425
6	1 - 24	15 - 40	34 - 127	84 - 103	80 - 203	1,467
7	1 - 17	14 - 62	25 - 105	32 - 146	93 - 234	447
8	5 - 18	20 - 43	36 - 69	116 - 135	113 - 132	31
9	NS	26 - 89	29 - 111	50 - 137	90 - 152	280
10	NS	12 - 25	30 - 95	40 - 107	150	153
11	1 - 10	26 - 37	30 - 89	49 - 91	88 - 112	34
12	5 - 10	20 - 60	55 - 108	65 - 142	94 - 102	22
14	2 - 15	20 - 50	42 - 102	75 - 107	104 - 206	26
15	1 - 10	19 - 32	72	54 - 126	123	163
16	1 - 16	10 - 50	34 - 106	55 - 183	87 - 206	941
17	2 - 22	14 - 46	32 - 126	46 - 140	57 - 144	600
18	1 - 20	12 - 43	29 -122	38 - 173	80 - 170	1,766
19	1 - 10	10 - 83	49 - 85	48 - 152	72 - 112	107
20	1 - 17	10 - 49	30 - 133	51 - 170	72 - 234	1,872
21	3 - 15	16 - 44	40 - 85	47 -120	180	203
22	5 - 20	15 - 40	40 - 96	38 - 143	46 - 156	227
23	3 - 15	15 - 72	50 - 91	51 - 127	75 - 159	216
24	10 - 19	24 - 37	97	57 - 132	71 - 102	10
25	3 - 17	42	76	76 - 166	97	285
26	2 - 15	19 - 95	30 - 92	75 - 135	104 - 122	43
27	5	32 - 61	60 - 156	102 - 166	152 - 177	37
28	2 - 20	20 - 53	58 - 112	60 - 108	87 - 225	64

NS= Size Class not sampled.

Old Growth. Old growth attributes were assessed during field sampling and reconnaissance. No old growth stands were detected during field inventory (Sandbak, 2018A). However, small microsites (< 1 acre and generally less than 1/2 acre in size) were detected that met minimum attributes of old growth for age, diameter, and basal area (Greene et. al., 1992). One area was found in each of the following units: 8, 15, 25, 104, 175, and 180.

Forest Vegetation Structure – Horizontal (Basal Area/Acre and Canopy Cover) and Vertical (Canopy Layers)

The existing forest structure in the project area is primarily due to past disturbance, active fire suppression, past management activities and wildfire. In terms of vertical structure the following conditions exist. The dominant vertical structure type is multi storied (continuous 97.3%) with single story on the remaining 2.7% (Table 7). Ponderosa pine types tend to develop as 2 storied and then multistory. Without large disturbances at age 60 to 80 they can develop into three or more canopy layers. This is primarily due to stand dynamics and small disturbance events (insects, disease, fire management, wind, snow damage, competition) that open canopies up to allow regeneration to establish.

The project area is dominated by a canopy cover class (horizontal structure) of 25 to 39.9%. About forty percent has a canopy cover greater than 40%. Table 7 displays that 4.2 % has a canopy cover greater or equal to 60%, and 19.5% have a canopy cover of 10-24.9%. Thirty six percent has a canopy cover between 40 and 59%.

Table 7: Average Existing Canopy Cover and Canopy Layer by Percent of Forested Area

Canopy Class	Acres	% of Existing Forested Area
10 - 24.9%	2,368	19.5%
25 - 39.9%	4,888	40.3%
40 - 59.9%	4,364	36.0%
60 % plus	517	4.2 %
Total	**12,137**	100%

Canopy Layer	Acres	% of Existing Forested Area
1	332	2.7%
2	0	0%
3	0	0%
Continuous	11,805	97.3%
Total	**12,137**	100%

The average basal area per acre (BA) for the existing forested area in the project area is 124 with a range of 62 to 166 (Sandbak, 2018C, 2018D, 2018H, 2018I, and 2018J). About 65% is between 120 and 150, 3% less than 80, 3% greater than 150, and 28% between 80 and 120 (Table 8).

Table 8: Average Basal Area per Acre by Percent of Forested Area

Average Basal Area Per Acre Range	Acres	% of Forested Area
< 80	391	3.2%
≥ 80 and ≤ 120	3,441	28.3%
>120 but < 150	7,909	65.2%
≥150	396	3.3%
Total	**12,137**	**100%**

Forest Vegetation – Insect Hazard (Beetle)

Insects highlighted as a concern in this analysis are 2 types of bark beetles (mountain pine beetle and pine engraver beetle). The existing condition and potential hazards for mountain pine beetle and pine engraver beetle is discussed in this analysis.

Aerial detection surveys have been conducted by Regional Forest Health Protection personnel (FHP) over a period of 14 years (Figure 1). For the surveyed years between 2001 and 2014 mountain pine beetle had a peak infestation in 2004 on about 1,600 acres. Four of the years had between about 200 and 400 acres. The remaining years has less than 100 acres with 2 years where there was no detection. The pine engraver beetle had a peak of 4,300 acres in 2005. Three years had between 100 and 200 years each. All remaining surveyed years had no detections of pine engraver beetles. Both bark beetles have been at relatively low levels on the landscape. Localized areas have experienced higher mortality.

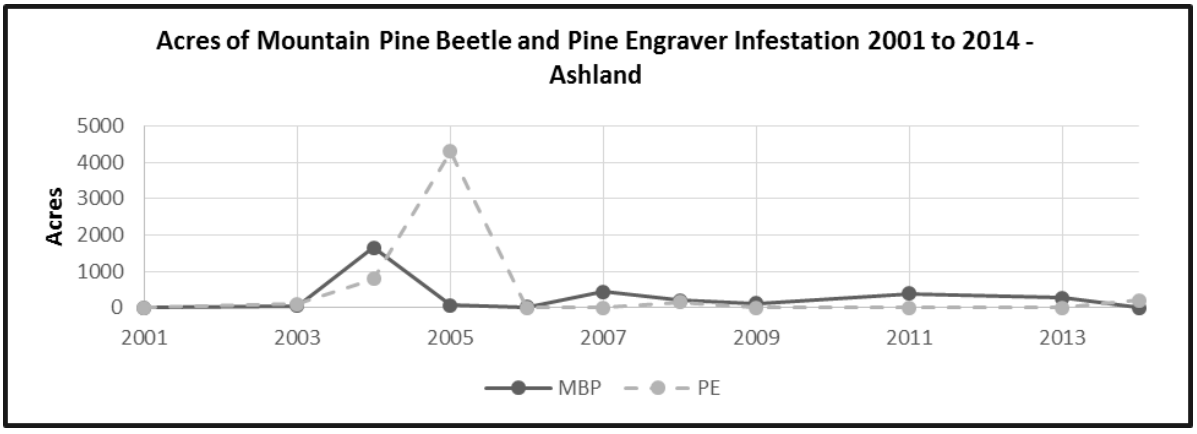


Figure 1: Acres of mountain pine beetle infestations by species from 2001 to 2014 Ashland Ranger District, USDA R1-FHP Aerial Detection Surveys

Regional FHP entomologists and an inventory specialist have developed a hazard rating system for combined pine beetles (which include mountain pine beetle and engraver beetle) that can be used with inventory data (Randall, Steed, Bush, 2011). This hazard rating evaluates the susceptibility of forests by evaluating the quality of the host and quantity of the food source. For example, the quality of the host component of a stand as a food source is best characterized by stand density and phloem thickness for some insects (i.e. pine beetles). Since phloem thickness is not generally measured in inventories, diameters, basal areas, and other available stand characteristics are used as surrogates. The quantity of the food source refers to the species composition and density of the forest. For example, a pure, well stocked ponderosa pine stand will be more likely to support a large mountain pine beetle population than a mixed species and/or poorly stocked stand. These hazard ratings do not predict when or if significant mortality will occur as there has to be not only the susceptible host present, but an insect population and favorable weather conditions. They can be used to help determine current hazard and model hazards over time with or without management disturbances.

Randall, Steed and Bush (2011) developed four hazard categories that include None (no host species), Low (host present but not in high enough quality and/or in large enough quantity to allow forest insect populations to remain at high levels), and Moderate and High (both that could result in mortality (large amounts or lesser amounts) dependent on which insect populations are present and if the weather is favorable). The evaluation of the host and determination of the hazard considers attributes of total basal areas (densities), quadratic mean diameters (QMD) and the percent of total basal area represented by the host species. Values are assigned to these attribute (Low=.5, Moderate=2, and High=3). These attributes vary according to the individual insect hazard rating system (Randall, Steed, Bush, 2011). These are then multiplied together and assigned a final calculated hazard and then a hazard rating as shown in Table 9.

Table 9: Calculated Hazard Values

Hazard	Calculated Hazard	Hazard Rating
Extremely Low/None	0	None
Low	<2	Low
Moderate	2-17	Moderate
High	≥ 18	High

Mountain pine beetle (*Dendroctonus ponderosae*) is a native bark beetle which attacks all species of pine and is capable of causing widespread tree mortality. Each bark beetle species exhibits a preference for trees of a certain size (Fettig and Hilszcanski 2015). Bark beetles are host specific and susceptibility is dependent on attributes like tree diameter, density, and current beetle activity along with environmental conditions (i.e. drought, wind events, snow breakage, lightning strikes) (Gibson, 2004). Mountain pine beetle is generally attracted to the largest trees available (Preisler and Mitchell 1993).

Mountain pine beetle is the most aggressive, persistent and destructive bark beetle. This beetle attacks the host and the larvae feed on the inner portion of the bark (cambium) that may result in girdling of the tree. This girdling reduces or eliminates the ability for the tree to transport water and nutrients to the tree, resulting in mortality. Stand conditions conducive to infestations are pine stands that are dense and have a combined pine species component of trees larger than 7" diameter breast height (DBH). Tree death caused by this girdling, is aided by blue-stain fungi (Amman and Logan 1998). Mountain pine beetle prefers dense, shady stands because the microclimate is conducive to survival and communication, and trees are less vigorous (Bartos and Amman 1989; Preisler and Mitchell 1993). Most bark beetle species have a preference for larger trees often with declining radial growth, growing in high density stands with a high percentage of host type (Fettig and Hilszcanski 2015). Typically an outbreak continues until the beetle runs out of host (food) or weather ceases to be conducive, although parasites and predators are also important regulating factors especially when populations are at endemic levels (Amman and Cole 1983). Weather that regulates mountain pine beetle includes extreme cold for extended periods in the

winter, late spring or early fall frost, and wet springs/summers (ibid). Abiotic factors including temperature, moisture, and physiographic site conditions such as soils and elevation may also influence tree vigor and stand susceptibility (Six and Bracewell 2015). Frequency of outbreaks generally ranges from 20 to 40 years (Cole and Amman 1980); however, outbreak periodicity is strongly influenced by forest stand conditions. Beetle infestation can result in more open canopies that provide regeneration opportunities for shade intolerant trees.

Egan has noted beetles may completely deplete pine forests and, in some cases, have converted forests to other species (Egan, 2013). Sometimes, forested areas are converted to grass and shrubs. The profusion of beetle-killed trees can change wildlife species composition and distribution by altering hiding and thermal cover and by impeding movement. Tree mortality may increase the water yield for several years following an infestation. Moreover, the dead trees left after epidemics are a source of fuel that will, in time, burn if not removed.

Ponderosa pine is the only susceptible host in the project area. Mortality has recently been observed in ponderosa pine while conducting field inventory in 2017 (field inventory data available in project record). Individual tree mortality has been observed as scattered individual trees and groups of trees ranging from 2 to 3 trees. Unsuccessful beetle attack was also noted that will not result in mortality.

Management should focus on altering the stand conditions that predispose stands to beetle infestations. There are two strategies, including long term (preventative) forest management and direct control to reducing losses from mountain pine beetle.

Preventative management should be designed to increase tree/stand resistance that focuses on stands susceptibility. This is the most long term solution. Combinations of hazard ratings, priority settings, and silvicultural manipulations are the best management tools.

Effects of suppression or direct control of the beetles is only temporary. Direct control might be effective in reducing rate of spread and intensification of infestations, but is only a temporary measure until susceptible stands can be altered by silviculture treatments. Direct control is expensive in time, effort, and resources. For suppression tactics to be successful the following should occur: early detection and control action over entire infested area within one to two years; continue control work as long as necessary; and thorough treatment and follow-up surveillance.

For high value trees in campgrounds, picnic areas, visitor centers, and around permanent and summer homes protective chemicals have been very effective. Carbaryl has been shown to be effective for up to 2 years (Gibson, 2004). Verbenone an anti-aggregative pheromone has been used but has shown less reliable results in protection (Gibson, 2004).

More recently a semio chemical has been synthesized, packaged and marketed in the form of aggregative tree bait. The intent here is to capture the natural message bearing chemical that beetles send out to mass attack individual trees. These baits are then used in various baiting strategies in combination with logging to essentially contain beetle populations in stands scheduled for harvest.

Preventative forest management to reduce susceptibility to beetles includes species conversion, clearcutting, stocking control (thinning), salvage and sanitation cutting for preventative and control of beetle infestations.

Studies have shown that stand-level density reduction or thinning is the most effective long-term means to reduce bark beetle-caused mortality in ponderosa pines stands. Thinning can reduce inter-tree competition

and promote long-term benefits as residual trees gain greater access to limited commodities (light, water, nutrients, and overall growing space (Oliver and Larson, 1990). Residual trees in thinned areas exhibit increased tree growth, vigor, and resilience to bark beetle attack and drought-related tree mortality. Thinning treatments can also enhance residual tree resilience to MPB attack by altering stand microclimate; in effect, reducing environmental conditions conducive towards bark beetle dispersal, communication, aggregation, and/or reproduction. Microclimate variables thought to be important include pheromone plume stability, wind speed, and bark temperature (Amman and Logan, 1998; Thistle et al., 2004).

Fettig in 2007 also notes multiple experimental research studies have assessed density reduction treatments and consistently report that thinning is a viable tool to reduce bark beetle-caused tree mortality in ponderosa pine plantations (Fettig et al., 2007). Stand-level thinning to residual spacing targets, even in stands adjacent to active bark beetle caused-mortality centers, has been shown effective in reducing MPB-caused ponderosa pine mortality in various locations (Hall and Davies, 1968; McCambridge and Stevens, 1982; Oliver, 1995; Cochran and Barrett, 1998; Schmid and Mata, 2005; Schmid et al., 2007; Egan et al., 2010). However, thinning plantations without spacing targets can leave a clumped distribution of residual trees with high local density values that can remain susceptible to bark beetle-caused tree mortality (Whitehead and Russo, 2005; Whitehead, 2010).

Additional studies have shown that thinning in second growth ponderosa pine has been found to have a large impact on beetle caused mortality. Unthinned stands with 152 square feet of basal area (BA) per acre have been shown to have 8 percent of the stand killed over 5 years. In similar stands that were thinned to less than 80 square feet per acre showed 0.2 percent mortality over the same period of time (Gibson, 2004). Thinning may not be as effective if thinned next to an unthinned infested stand. Thinning has also been documented to reduce levels of mortality in ponderosa pine when basal areas were thinned to 45 to 85ft^2/acre (Fettig, et al, 2013). These studies also indicated that thinning reduces host availability that supports beetle populations, reduces competition among trees for nutrients, water, and other resources thereby increasing vigor and affects microclimate decreasing the effectiveness of chemical cues used in host finding, selection and colonization and influencing beetle survival. Thinning from below may optimize the effects of microclimate, inter tree spacing, and tree vigor even if the residual trees are of diameter classes considered more susceptible to attack (Fettig, et al, 2013). In ponderosa pine silvicultural treatments for minimizing losses includes salvaging infested trees, thinning to BA of 80 square feet per acre with continued surveillance, and salvage and thinning to maintain low stand densities (Gibson, 2004).

Graham et al. (2016) found in their work that analyzed plots with basal areas greater than 90 ft^2 generally experienced major MPB mortality in the Black Hills. Stands and landscapes with tree densities ranging from 40 to 80 ft^2 showed considerable resistance to MPB's. They concluded that this outcome was likely related to the disruption of pheromone plumes facilitated by the open canopy conditions.

Hood et al (2016) indicated thinning treatments with or without fire, dramatically increased tree growth and resin ducts relative to their control and burn-only treatments. Prescribed burning did not increase resin ducts but did cause changes in resin chemistry that may have affected MPB communication and lowered attack success. Their results concluded treatments designed to increase resistance to high-severity fire in ponderosa pine dominated forests can increase resistance to MPB, even during an outbreak. Their study suggests that fuel and restoration treatments in fire-dependent ponderosa pine forests that reduce tree density increase resilience in the short term, while the reintroduction of fire is important for long-term resilience.

Landscapes tend to become more homogenous as fire is removed because succession will eventually advance all stands to similar communities (Keane, et al, 2002). Landscape structure (spatial distribution of patches) also changes with fire exclusion as landscapes generally become less fragmented, have lower patch density, and evolve decreased patch diversity, which often results in more contagion, corridors, and large patches (Keane, et al, 2002).

Hessburgh et al (2015) also indicates altered disturbance regimes have led to increased homogeneity in terms of vegetation structure, composition, and the spatial patterning of patches across the landscape. Heterogeneity refers to the uneven distribution of various concentrations of different composition and structure attributes of vegetation types or cover types occurring on the landscape. Heterogeneity in forested landscapes can generally be characterized where a variety of patch sizes of early seral to late seral vegetation in various structure stages occurs. Homogeneity on the other hand is the opposite, such as where fires have been excluded and large forested landscapes have become dominated with high tree densities and multiple-layer canopy structures. Heterogeneity generally reduces the extent of disturbances such as fire and insect outbreaks on the landscape (Hessburg et al. 2015). Resilient landscapes are generally made up of mosaics of age classes, composition, structures, and successional stages (heterogeneity). This variability ensures that not all areas are equally susceptible to the same drivers at the same time. Spatial heterogeneity has implications for important ecosystem services such as reforestation, timber productivity, wildlife habitat quality, watershed health, and carbon storage (Turner et al. 2012).

An indirect treatment option in homogeneous susceptible host landscapes is to change forest structure and composition to increase resiliency (Fettig, et al, 2013). Clearcutting in small to moderate sized areas will create age and size mosaics within landscapes of homogenous even-aged forests that ultimately reduce impacts by the mountain pine beetle (Fettig, et al, 2013).

Interpreting MPB Hazard

To be rated as a low hazard, forested areas with pine species generally have to have a quadratic mean diameter (QMD) $\geq$ 5" diameter breast height (DBH) and less than 80 ft^2 of BA/acre in all species, and <25% of the BA $\geq$ 5" DBH in a pine species. To be rated moderate or higher, the QMD has to be 6" or greater with basal areas greater than 80 ft^2per acre and more than 25% of BA of pine species $\geq$ 5" DBH.

A pure, well stocked pine species stand will likely support a large mountain pine beetle population compared to a mixed host and non-host species and/or poorly stocked stand. When high-hazard stands are intermixed with low-hazard stands, beetle populations may not be as active. Low-hazard stands may have the host, but are either not of high enough quality or in large enough quantity to allow beetle populations to remain at high levels. Mountain pine beetle may still cause significant mortality in the pine components of low-hazard stands in a landscape, but losses will be lower than in a landscape where high-hazard stands are clustered.

Table 10 displays the hazard rating by percent of the project area. About 1.3% of the project area has a rating of low (insufficient quantity and quality of ponderosa pine for significant mortality). Over 98% of the forested areas has a rating of moderate and high, with the highest amount in the moderate hazard (89.9%). This indicates that there is a sufficient quantity and quality of host available in the project area. If beetles are present and weather conditions are favorable, significant mortality may occur on 89.9% or more of the forested project area.

Table 10: Acres of Pine Beetle Hazard by Percent of Forested Area

Beetle Hazard	Acres	% of Existing Forested Area
Low	164	1.3%
Moderate	10,910	89.9%
High	1,063	8.8%
	12,137	**100%**

Forest Vegetation - Planting

An effect from large stand replacement fire events is a potential loss of the ponderosa pine forest cover (deforestation) for long periods of time. Ponderosa pine has a thick bark that acts as an insulator and long needles that protect its buds to withstand effects from frequent low intensity fires. Ponderosa pine has a large, heavy seed and does not have the ability to reseed large disturbance areas in short time frames like other small winged pine species such as lodgepole pine. Average seed cast is 1 to 3.5 tree heights (Shepperd and Battaglia 2002; Minore and Laacke, 1992). Ponderosa pines large seed and cone generally are destroyed and do not remain after stand replacement fire events. If all the trees have been killed no seed source is available to reforest the area. Ponderosa pine forests that have had large fires over the last 20 to 25 years in eastern Montana have demonstrated this. Left alone portions of these fires would take several decades to reforest. This loss of the forest has impacts to wildlife that are dependent on forested communities. The Kraft Springs fire is an example of this (Sandbak, Clark, 2005). The forested landscape was reduced (deforested) by 69% (Sandbak and Clark 2005) from fire caused mortality from the 1988 Brewer Fire and the 2002 Kraft Springs Fire. Several thousands of acres were deforested with limited seed sources. Many of these wildfire acres were put into a delayed regeneration strategy (forest cover return taking few to several decades) and natural regeneration strategy (forest cover return < 10 years). Areas assessed that were lacking a seed source and on the cooler, moist sites that were deemed important for timely reforestation were artificially reforested.

To comply with the National Forest Management Act, Forest Service Directives, and meet forest cover management goals and standards in the Forest Plan the Custer Gallatin National Forest (eastern portion) has identified three strategies for ensuring forest lands impacted by fires are maintained or put on a trajectory to return forest cover post wildfire disturbance. Those strategies include:

1. On forest land where fires have resulted in ***low mortality*** those areas will be monitored to assess the forest cover. An assessment will include potential delayed mortality from the fire or insects and if the forest cover will still meet the intent of the management direction in the Forest Plan.
   - ***No Treatment:*** No further treatment and no further monitoring needed or
   - ***Natural Regeneration:*** Monitoring for natural regeneration success to meet the Forest's certification standards.

2. On forest land where fires have resulted in ***moderate mortality*** those areas will be monitored to assess the forest cover. An assessment will include potential delayed mortality from the fire or insects and if the forest cover will still meet the intent of the management direction in the Forest Plan.
   - ***Natural Regeneration:*** Where adequate seed source is available, monitoring for natural regeneration success to meet the Forest's certification standards.
   - ***Artificial Regeneration:*** Where adequate seed source is not available on moist sites (N, NW, NE and E) to restock to certification standards in 5 to 10 years post fire, artificial planting will be evaluated.

- ***Delayed Regeneration:*** Where adequate seed source is not available on dry sites (SE, S, SW, and W) to restock to certification standards in 5 to 10 years post fire these areas will be put into a delayed regeneration status with long natural recovery periods anticipated.

3. On forest land where fires have resulted in ***high mortality*** those areas will be monitored to assess the forest cover. An assessment will include potential delayed mortality form the fire or insects and if the forest cover will still meet the intent of the management direction in the Forest Plan.
   - ***Natural Regeneration:*** Where adequate seed source is available, monitoring for natural regeneration success to meet the Forest's certification standards.
   - ***Artificial Regeneration:*** Where adequate seed source is not available on moist sites (N, NW, NE and E) to restock to certification standards in 5 to 10 years post fire artificial planting will be evaluated.
   - ***Delayed Regeneration:*** Where adequate seed source is not available on dry sites (SE, S, SW, and W) to restock to certification standards in 5 to 10 years post fire these areas will be put into a delayed regeneration status with long natural recovery periods anticipated.

The project area has a large wildfire footprint of 11,188 acres from 2000 to 2012. The strategy above was conducted across the Ashland District in 2014 for large wildfires since 2000 (USDA, 2014). Within the project area this strategy indicated the following:

Table 11: Reforestation Strategy on Past Wildfire Areas within the Project Area

Reforestation Strategy	Acres	Percent
Natural Regeneration	3,414	80%
Artificial Regeneration (Planting)	280[1]	7%
Delayed Natural Regeneration	547	13%
Total	4,241	100%

[1]Further refinement with field inventory reduced planting needs to 253 acres.

Planting on the Ashland District has only been implemented on large fire areas where there has not been an adequate seed source to reforest the area. The strategies above are field validated to determine needs based on the forest stocking objectives (see project design features above). Two hundred and fifty three acres are still tentatively identified as lacking a seed source and currently unstocked.

Below is a summarized table for the existing condition for the resource indicators over the 3 time periods.

Table 12: Resource indicators and Measures for Existing Condition and No Action Alternative

Resource Element	Resource Indicator	Acres	% Existing Forested Area	Measure (% Change from Existing to 2021)	Measure (% Change from Existing to 2041)
Forested Vegetation Composition - Size Class	<1"	0	0.0%	0.0%	0.0%
	.1- 4.9"	21	0.2%	0.0%	0.0%
	5 - 9.9"	653	5.4%	0.0%	0.0%
	10- 14.9"	11,296	93.1%	0.0%	0.0%
	15" Plus	167	1.4%	0.0%	0.0%
Forest Vegetation Structure – Horizontal (Basal Area per acre)	< 80	391	3.2%	0.0%	-1.8%
	≥ 80 and ≤ 120	3,441	28.3%	0.0%	-24.1%
	>120 and < 150	7,909	65.2%	0.0%	-39.2%
	≥150	396	3.3%	0.0%	+65.1%
	10-24.9%	2,368	19.5%	0.0%	-14.6%
	25-39.9%	4,888	40.3%	0.0%	-15.6%

Resource Element	Resource Indicator	Acres	% Existing Forested Area	Measure (% Change from Existing to 2021)	Measure (% Change from Existing to 2041)
Forest Vegetation Structure – Horizontal (Canopy Cover)	40-59.9%	4,364	36%	0.0%	+5.0%
	60% plus	517	4.2%	0.0%	+25.2%
Forest Vegetation Structure –Vertical (Canopy Layers)	1	332	2.7%	0.0%	-2.5%
	2	0	0%	0.0%	+2.5%
	3	0	0%	0.0%	0.0%
	Continuous	11,805	97.3%	0.0%	0.0%
Forest Vegetation – Pine Beetle Hazard	Low	164	1.3%	+0.3%	-1.1%
	Moderate	10,910	89.9%	-0.1%	-83.7%
	High	1,063	8.8%	-0.4%	+84.8%
Forest Vegetation - Planting	Acres Planted	0	0.0%	0.0%	0.0%

Environmental Consequences

Alternative A – Proposed Action

Project Design Features, Mitigation, Monitoring Common to Action Alternatives

1. **Silvicultural Prescription:** Preparation and approval of detailed silvicultural prescriptions for all treatment units. *Applicable to all treatment units in forested stands.*

2. **Treatment Deviations:** treatment deviations as a result of changed or unidentified conditions that materially affect the intended treatment as described in the detailed site specific silvicultural prescription will be consulted with by the Project Silviculturist. As needed, the silvicultural prescription will be modified and re-approved by a certified silviculturist. *Applicable to all treatment units.*

3. **Leave Tree Protection:**

    a. During implementation, contractor will take all reasonable care to avoid damage to the roots, bole, and crown of live trees that will be reserved from cutting. When any live tree is damaged beyond recovery (expected to die within 1 year) that was intended to be retained, it can be removed or otherwise treated by the contractor as instructed by the Forest Service. *Applicable to all treatment units.*

    b. No old growth stands were found during field inventory (Sandbak, 2018C). However, small microsites (< 1 acre and generally less than 1/2 acre in size) were detected that met minimum attributes of old growth for age, diameter, and basal area (Greene et. al., 1992). One area was found in each of the following units: 8, 15, 25, 104, 175, and 180. Units 15 and 175 have no proposed treatment in Alternative A and Unit 175 has no treatment in Alternative B. Units 8, 25, and 104 have commercial harvest proposed with no prescribed burning, Unit 180 has commercial harvest and prescribed burning under Alternative A. Under alternative B, units 8, 15, 25, and 104 have commercial harvest proposed with no prescribed burning, Unit 180

has commercial harvest and prescribed burning. Within these small areas in these units, trees ≥ to 17" dbh and ≥ 180 years old will be marked as leave trees to maintain the minimum old growth attributes. During implementation, the Silviculturist will be notified if any additional areas are detected. These areas will be assessed and prescriptions modified to ensure old growth attributes are maintained. *Applicable to Units 8, 25, 104, and 180 in Alternative A and Units 8, 15, 25, 104, 175, and 180 under Alternative B.*

c. Individual large trees ≥ 17 inches and ≥ 180 years are widely scattered throughout the project area. These typically have flat-tops, small live crowns, thinning crowns, thick fissured orange colored bark, stem rot, with many having old fire scars on base of the tree bole. When encountered in the proposed commercial treatment units, these individual trees (if not a safety hazard) will be marked as leave trees and retained and serve as replacement snags. Prior to burning fuel accumulation (woody debris and duff) will be pulled back as needed from these individual trees. *Applicable to all commercial treatment units with and without RXB PP.*

d. Where available, while maintaining the average leave trees per acre, leave 1 to 3 clumps per acre of 2 to 4+ TPA with interlocking crowns in the ICD units and thinning areas within the CTM units. *Applicable to ICD and thinning areas of the CTM areas, not applicable to small openings on CTM units and REGEN ST units.*

- **Trees > 9 inches dbh** - Maintain clumps of trees with interlocking crowns by leaving 1 to 3 clumps per acre of 2 to 4+ trees.
  - Maximum distance of tree stems within clumps should be about 20 feet to ensure interlocking crowns.
  - Spacing between clumps will vary and will be based on where natural clumping of trees occurs. Where possible clumping will be scattered across the treatment area.
  - Tree clumps would generally have greater than 40% canopy cover.
  - Tree clumps would average 1-8% of treated area and worked into the average leave trees per acre.
  - Preference for clump placement should be around existing snags.
- **Post-Sale Thinning Activities Trees 5 to 9 inches dbh** – Promote clumps of trees with interlocking crowns by leaving 1 to 3 clumps per acre of 2 to 4+ trees.
  - Maximum distance of tree stems within clumps based on existing crown diameters and/or ability to expand to interlocking crown.
  - Spacing between clumps will vary and will be based on where natural clumping of trees occurs. Where possible clumping will be scattered across the treatment area.
  - Tree clumps would average 1-8% of treated area and worked into the average leave trees per acre.
  - Preference for clump placement should be around existing snags.

e. Areas > 1 to 2 acres in size within the ICD units with moist aspects will have trees marked according to the CTM average spacing (15 to 25 trees). Dry areas > 1 to 2 acres in size within the CTM units will have leave trees marked according to the ICD average spacing (1 to 10 trees). This will promote density diversity within the CTM and ICD treatment areas.

4. **Landing Piles:** Where possible landing piles should not occur near live green trees. Landing piles will be burned and the sites rehabilitated. *Applicable to all commercial treatment units that will have landings.*

5. **Windthrow:** Avoid layout of cutting unit boundaries with wind catching indentations, long straight lines or square corners. Long straight lines and square corners deflect wind and increase windthrow. Create irregular cutting boundaries without sharp indentations or square corners to lessen the opportunity for deflection and funneling of air currents. *Applicable to all commercial treatment units.*

6. **Pine Engraver Infestation Susceptibility:** Reduce pine engraver infestation susceptibility. For proposed commercial and non-commercial thinning activities, when treating 3 inches and larger activity slash on site, lop into small pieces to expose to sunlight to dry it out or do not create slash from January through July making it less suitable for beetle colonization. Landing piles should be a minimum of 20 feet wide and 10 feet deep to attract emerging beetles deeper into piles. Minimize logging damage to leave trees and avoid scorching leave trees when burning activity fuel piles to prevent population buildup and subsequent tree killing. *Applicable to all commercial treatment units.*

7. **Natural Regeneration:** Prepare seedbed for the establishment of natural regeneration on treatment sites intended for conifer reestablishment. Expose 10-15% bare mineral soil scattered across the treatment area, accomplished by mechanical harvest treatment activity or broadcast burning. Ensure every treatment unit receiving a regeneration harvest will meet or surpass stocking guidelines and certification standards within 5 years (USDA, 2006 and Table 13). Large openings ($\geq$ 2 acres) created by prescribed burning will be monitored to ensure restocking. Monitoring will occur the 1st, 3rd, and 5th year after harvest/treatment. Areas not progressing to certification by year 3 will be reevaluated for further treatment needs. To protect seed trees, fuel accumulation (woody debris and duff) will be pulled back as needed from designated seed trees prior to prescribed burning in all units with a regeneration treatments. *Applicable to the small openings in the CTM units, REGEN ST units, and RXB PP units.*

Table 13: Minimum Trees per Acre and % Stocked Area by Suitability for Certification of Regeneration.

Habitat Type[1]	Aspect	TPA	% Stocked Area[2]	Suitability
110, 130, 191	All	15 - 25	15 - 25	Unsuitable
140, 141, 192	SW, W, S, SE	15 - 25	15 - 25	Unsuitable
140, 141, 192	NW, N, N, NE, E	50 - 100	25 - 50	Unsuitable
170, 171, 172, 180, 181, 182 193, 194, 195	SW, W, S, SE	50 - 100	25 - 50	Unsuitable
170, 171, 172, 180, 181, 182 193, 194, 195	NW, N, N, NE, E	100 - 200	80% +	Suitable

[1] Pfister et.al. 1977 and Hansen, Hoffman. 1988.
[2]Percent capable growing area stocked to the minimum TPA for certification listed to the left.

8. **Artificial Regeneration:** Use of ponderosa pine seed approved by the forest Silviculturist to ensure adaptability to sites within the project area. Regional seed transfer guidelines will be adhered to. Monitoring as a minimum the 1st and 3rd growing season to ensure stocking objectives are met (Table 13). Areas not meeting certification standards by year 3 will be reevaluated for additional treatment needs. *Applicable to PLT treatment units.*

9. **Prescribed Burning Over story Mortality:** Management Strategy to Achieve Prescribed Fire Goals. *Applicable to all treatment units with broadcast burning.*

Table 14: Management Strategy for Prescribed Fire

			Management Strategy to Achieve Prescribed fire Goals		
Treatment	**Code**	**Approximate Ratio of Ground Area Burned: Unburned**	**Percent of Area in Fires Created Canopy Openings**	**Average Fire Created Canopy Opening Size in Acres**	**Percent Fire Created Overstory[1] Tree Mortality**
Commercial Improvement Cutting Activity (Dry) and Broadcast Burning	ICD	90:10	≤ 3	.5	≤ 10
Commercial Thinning Activity with Small Regeneration Openings (Moist) and Broadcast Burning	CTM	70:30	≤ 3	.5	≤ 10
Commercial Regeneration Treatment Activity and Broadcast Burning	REGEN ST	90:10	≤ 3	.5	≤ 10
Broadcast Burning in Ponderosa Pine	RXB PP	70:30	≤ 5	1	≤ 20

[1]Trees larger ≥ 9" dbh.

Direct and Indirect Effects

Direct effects for this analysis is the effects of implementing the treatment, these are described in terms of post treatment. Indirect effects are what happens as stands continue to grow and develop post treatment and are displayed for this analysis 20 years from treatment.

The overall intent for forest vegetation management is to change existing forest vegetation composition and structure to conditions that may be more resilient to disturbances such as outbreaks of pine beetles (MPB and engraver beetle) and wildfires, by creating variable densities of individual trees, providing for clumps and creating openings (ICO concept). Wildfire hazards are discussed in detail in the fire-fuels section of Chapter 3, and are therefore not covered in detail in this analysis.

Outbreaks of mountain pine beetle and large uncontrollable stand replacement wildfire have the greatest chance to affect the forest vegetation in the Threemile project area due to existing and projected forest composition and structure. Both of these disturbance events may result in socially unacceptable consequences. It is not the intent to beetle proof or fire proof the forest vegetation as these processes are important in the forest system and will all ways be a process on the landscape in these forest types. Three forest vegetation attributes that may determine whether there could be high mortality if an outbreak of mountain pine beetle were to occur include:

- Species (species dominance),
- Size class (successional status), and
- Horizontal structure (BA/ac.)

The following discussion will be focused on these forest vegetation attributes and a discussion of how proposed treatments affect those attributes. Vertical Structure (canopy layers) is an important attribute for fire hazard and will be discussed across the proposed treatments and Alternatives.

Species Dominance:

Cover type after a disturbance is determined by site conditions, species present (pre and post disturbance) and seed availability. Ponderosa pine is the only conifer cover type in the project area and is a host to both MPB and the pine engraver beetle. Green ash cover type (woody draws) is confined to draws on less than three percent of the project area, no standalone treatments are proposed. However, incidental green ash draws that fall within the proposed harvest units will have 90% of the ponderosa pine removed (see Threemile Restoration and Resiliency Project Environmental Assessment Table 1 Proposed Treatment Prescriptions – WD Woody Draw Treatment Activity or Table 1 in scoping document). Ponderosa pine will stay the dominant cover type throughout the time periods across all proposed treatment types. An additional 240 acres of ponderosa pine cover type will be established by planting in the wildfire areas that currently is lacking an adequate seed source to reforest naturally. About 3,414 acres in the northern portion of the landscape will continue to reestablish ponderosa pine forest cover over the next decade as areas with a seed source post fire continue to reforest naturally.

Forest Vegetation Composition (Size Class and Age)

A direct effect of the small regeneration treatments (REGEN ST and CTM small openings) will initiate a new age class of ponderosa pine to create age class diversity. Alternative A accomplishes this on approximately 778 acres (Table 19). Indirectly the ICD (commercial thin from below on dry sites – to restore widely spaced large open grown conditions) will initiate a new age class on 948 acres while still maintaining a large tree component. Average age classes in the larger tree classes will not be altered in the CTM thinning treatment areas (954 acres) designed to thin from below, they maintain the larger trees with the existing age class (Table 6). A new age class will be created in the PLT treatments that have existing forest cover on 13 acres and on 240 acres of burned areas that are currently non forested. No treatment areas and the No Action Alternative will maintain the existing age classes. There will be trees regenerating in the understories of these intermediate (ICD and CTM thin areas) and no treatment areas that will be a younger age, however the over story trees age will be the dominant age class. Small areas of old growth that were identified during field sampling and any additional found during implementation will be maintained (see design features above). Additional old growth will be promoted overtime by retention of larger trees within some of the treatment areas (Table 19).

The main objective for the RXB PP and RXB NF treatments is not intended to create new age classes, however canopy openings up to 1 acre in size on less than 1 percent of the treatment unit may occur where a new age class will be started. Understories are likely to reinitiate post treatment.

Across the forested acres small disturbances (insects, disease, wind, snow, etc.) will occur and take out individual trees creating openings in the canopy, this may initiate regeneration, but the dominate age class will be the over story.

Woody draw treatments (WD) were designed to remove ponderosa pine, while maintaining all green ash and other deciduous species. With preference to leave the older larger ponderosa pine trees this age class will still be represented. A new age classes of green ash is anticipated beyond 2021 as a result from opening up the canopy. New germinates of green ash from seed are anticipated and root suckering could occur post prescribe burn.

Under Alternative A about 16% of the treated 4,759 acreage post treatment will initiate a new age class (Table 19). An additional 240 acres of existing non forest will be forested with the PLT treatment, adding acres of a new age class. The remainder of the 84% of the treated acreage will generally maintain the age class representation, with the ICD and CTM treatments targeting the older age classes for retention (Table 6). This is in comparison The No Action Alternative which maintains the existing condition and no new

age class is created, other than when small disturbances (insects, disease and storm mortality) occur. Remnant large, old trees (≥ 17" dbh and ≥ 180 years) noted in the field surveys will be retained/protected during commercial and prescribed fire activities (see design feature section). Natural mortality (age, insects, diseases, storm damage) and applying prescribed fire could reduce this large old tree component.

Creation of a new age class is a longer term strategy to increase resiliency to MPB outbreaks (see insect hazard section above). By changing the largely homogenous existing structure and composition in the ponderosa pine cover type, portions of the landscape will not be susceptible at the same time. This will reduce effects of a MPB outbreak if it were to occur. The REGEN ST, CTM small openings, and the PLT types of treatment specifically were targeted to create a new age class of ponderosa pine. A mix of small and medium sized openings through harvest will be created on 958 acres ranging in size from ½ to 10 acres for individual treatment units. Some of these individual openings that are adjacent will create openings up about 21 acres. No new age class and no alteration to the ponderosa pine cover type composition and structure will occur in the No Action Alternative.

Thinning increases growing space, promoting individual tree growth (increased diameter). Thinning from below and prescribed burning to reduce the understory components leaves the larger trees that in addition have an influence in the increase of acres in the large tree size class.

Forested Vegetation ICO Treatments (ICD, CTM, REGEN ST RXB PP, RXB NF, Post-Sale Non-commercial Thinning, NO TREAT and PLT):

ICD and CTM Thinning Treatments (Individual Trees/Clumps) – Opening up the canopies in the ICD thinning treatments will allow for a new age/size class to establish on some of the treated acreage. This is not represented in the table due to the dry sites (ICD treatment) and the anticipated longer periods for establishment and that the dominant size class tracked for this analysis and time period is large trees.

These treatments both entail thinning from below in the 9" plus size where the smaller diameter trees are taken out first leaving larger trees until desired TPA are met. Where available tree clumps will be maintained in the overstory (>9") on 1 to 8% of the thinned area. Trees will continue to age and grow in diameter with or without treatment. However, when growing space is increased as in thinning treatments they may respond by increasing diameter growth faster than if not treated. Effects from thinning from below can also reflect larger average diameter classes as you are leaving the largest trees. This is displayed in Tables 15 (Sandbak, 2018H). The best example to illustrate this is in a comparison for the ICD and CTM treatment units by looking at the top two diameter classes. Pretreatment these treatments have 94.6% of the acreage in the 10-14.9" class and 3.2% in the 15"+ class (Table 15). Post treatment, they have 31.6% of the acreage in the 10-14.9" class and 47% in the 15" plus class. By 2041, these treatments promote 1,165 acres in the 15" + class. In comparison the No Action Alternative has only 1.4% (167 acres) in the 15" plus class (Table 22). Larger tree classes are promoted in these treatments as compared to the No Action. This holds true for 2041, larger trees post treatment still are present but the smaller diameter trees (including new ingrowth, regeneration) have grown and are influencing the diameter classes. Alternative A still has higher acreage in the 15" + class (13.0%) when compared to the No Action of 1.4% (Table 22, Sandbak, 2018H).

REGEN ST and CTM Small Opening Treatments (Openings) - An effect from commercial regeneration small opening treatments (1/2 to 10 acres in size) is that a new size class and age class in the existing ponderosa pine cover type is introduced on the landscape that results in a

patch mosaic of younger, smaller trees as displayed in Table below (Sandbak, 2018H). This is in comparison to the No Action Alternatives where there is no representation of the <.1" size class in 2021. By 2041 Alternative A would have 854 acres (771 acres from these treatments) in the .1 to 4.9" size class, 6.8% more acres than the No Action Alternative (Table 15 and Table 22). Large trees (seed trees) in both treatment types will be reduced to 10 or fewer trees per acre (see the Threemile Restoration and Resiliency Project Environmental Assessment and Scoping Document (Table 1 in the Environmetal Assessment and Table 1 in Scoping Document) and will be retained as future legacy trees.

RXB PP and RXB NF Treatments (Clumps) - These treatments were designed to return fire to the landscape and reduce stocking, primarily in the understory. Although the RXB NF treatments are primarily non forested, patches of forested areas exist within the treatment boundaries. Intent of burn is not to create moderate or heavy mortality in the over story (Table 14). This is seen by the diameter class changes in Alternative A post treatment (Table 15). Existing understories (.1-4.9" and 5-9.9") were largely removed with very limited representation for these size classes in 2021 (<0.1%), in comparison these size classes represent 5.6% in 2021 in the No Action (Table 22). By 2041, 78.2% occurs in the 10-14.9" class and 18.7% in the 15"+ class. (Table 15). The No Action maintains a dominant 10-14.9" class through 2041 (Table 22). Even with the limited impact on the over story by these treatments, a small decrease in the 15"+ diameter class occurs in these treatment acres by 2041. This is largely due to the understory responding and pulling more acres into a lower average size class. With the designed management strategy for prescribed fire (Table 14), tree clumps are expected to be present post treatment. Large trees classes are maintained for both Alternative A and No Action, with a higher large tree dominance representation post treatment and in 2041 for the Alternative A (Table 15 and Table 22, and Sandbak 2018H).

Post-Sale Non Commercial Thinning in ICD and CTM Thin Treatments (Individual Trees/Clumps) - These treatments are designed to thin the understories (<9") in these harvested stands to promote a two story stand. Where vigorous understories occur they will be thinned to a 20 foot spacing (less than 100 trees per acre). Where available tree clumps will be maintained in the understory (5 to 9") on 1 to 8% of the thinned area. Size classes for this analysis are those represented in ICD and CTM treatments (Sandbak 2018H). The No Action Alternative maintains the same diameter classes as existing through 2041 (Table 22)**.**

No Treatment Areas (Skips) – On the average tree sizes with no major disturbance are not expected to change enough to have measureable changes in the analyzed 20 year period.

PLT – Planting is designed to create a new age class in the project area within previously burned areas. Planting densities may vary to meet the forests stocking objectives by year 5 (Table 13). Alternative A will promote 253 acres of a new size class (<.1"), 13 of those acres that have a forest component will have scattered small clumps of trees in the 10-14.9" class throughout the time period (Table 15, Sandbak, 2018H). By 2041, the ponderosa pine cover will have increased by 240 acres and ads diversity of size classes to the project area (Table 19).

WD Treatments (Individual Trees): These treatment areas are not focused on ponderosa pine but on restoration of the woody draw treatments, in particular the green ash component. These were designed to remove all but 10% of the largest ponderosa pine trees (see the Threemile Restoration and Resiliency Project Environmental Assessment and Scoping Document (Table 1 in the Environmetal Assessment and Table 1 in Scoping Document). These are presently not

identified as individual treatment areas. Pretreatment these WD areas are generally dominated by ponderosa pine 10-14.9%" size class (dominant existing size class). Post treatment these would become a dominant 15"+- green ash mix cover type with a smaller component of 5-9.9", due to removal of most of the ponderosa pine. By 2041 with additional regeneration of green ash and ponderosa pine the dominant size class would fall to a 10-14.9" with some still in the 5-9.9" class. This is in comparison to the No Action where the dominant 10-14.9"ponderosa pine size class stays throughout the 24 year time period.

Table 15: Alternative A - Acres of Size Class by Time Period by Treatment

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	Diameter Class (Inches)[1]	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
RXB PP	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	44	3.0%	+3.0%
	5 - 9.9"	28	1.9%	0	0.0	-1.9%	0	0.0%	-1.9%
	10- 14.9"	1,399	95.5%	1,078	73.5%	-22.0%	1,142	77.9%	-17.6%
	15" Plus	39	2.6%	388	26.5%	+23.9%	280	19.1%	+16.5%
	Sub Totals	**1,466**	**100%**	**1,466**	**100%**		**1,466**	**100%**	
RXB NF	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	2	0.4%	2	0.4%	0.0%	20	3.3%	+2.9%
	5 - 9.9"	31	5.1%	0	0.0%	-5.1%	0	0.0%	-5.1%
	10- 14.9"	559	93.3%	450	75.1%	-18.2%	473	79.0%	-14.3%
	15" Plus	7	1.2%	147	24.5%	+23.3%	106	17.7%	+16.5%
	Sub Totals	**599**	**100%**	**599**	**100%**		**599**	**100%**	
ICD	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	5 - 9.9"	31	3.2%	10	1.1%	-2.1%	50	5.2%	+2.0 %
	10- 14.9"	897	94.6%	263	27.7%	-66.9%	320	33.8%	-60.8%
	15" Plus	21	2.2%	676	71.2%	+69.0%	579	61.0%	+58.8%
	Sub Totals	**949**	**100%**	**949**	**100%**		**949**	**100%**	
REGEN	<.1"	0	0.0%	264	100%	0.0%	0	0.0%	-100%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	264	100%	+100%
	5 - 9.9"	1	0.2%	0	0.0%	0.0%	0	0.0%	0.0%
	10- 14.9"	251	95.2%	0	0.0%	0.0%	0	0.0%	0.0%
	15" Plus	12	4.6%	0	0.0%	0.0%	0	0.0%	0.0%
	Sub Totals	**264**	**100%**	**264**	**100%**		**264**	**100%**	
CTM	<.1"	0	0.0%	507	34.5%	+34.5%	0	0.0%	0.0%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	507	34.5%	+34.5%
	5 - 9.9"	20	1.4%	0	0.0%	-1.4%	0	0.0%	-1.4%
	10- 14.9"	1,391	94.7%	500	34.1%	-60.6%	375	25.6%	-69.1%
	15" Plus	57	3.9%	461	31.4%	+27.5%	586	39.9%	+36.0%
	Sub Totals	**1,468**	**100%**	**1,468**	**100%**		**1,468**	**100%**	
NO TREAT	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	18	0.2%	18	0.2%	0.0%	18	0.2%	0.0%
	5 - 9.9"	543	7.4%	543	7.4%	0.0%	543	7.4%	0.0%
	10- 14.9"	6,785	92.0%	6,785	92.0%	0.0%	6,785	92.0%	0.0%
	15" Plus	32	0.4%	32	0.4%	0.0%	32	0.4%	0.0%
	Sub Totals	**7,378**	**100%**	**7,378**	**100%**		**7,378**	**100%**	
PLT	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	5 - 9.9"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	10- 14.9"	13	100%	13	100%	0.0%	13	100%	0.0%

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	Diameter Class (Inches)[1]	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
	15" Plus	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Sub Totals	**13**	**100%**	**13**	**100%**		**13**	**100%**	

[1]Diameter at 4.5 feet.

Forest Vegetation Structure – Horizontal (Basal Area/Acre and Canopy Cover) and Vertical (Canopy Layers).

Horizontal - Basal Area

Basal area per acre (in combination with diameter) is an important attribute in determining potential hazards for the insect of concern (MPB). Eighty square feet per acre and QMD's $\geq$ 6 " is the break between a low hazard rating and moderate hazard rating for MPB (see interpreting MPB hazard above).

Treatment Effects: Type of treatment activity, existing stand conditions, and existing site condition are a function of existing and future average basal areas. Table 16 displays how basal area changes from treatment types and how they change as stands reestablish or increase in growth over the 24 year time period. Regeneration harvests (REGEN ST), improvement cutting on dry sites (ICD), and small openings in the commercial thinning (CTM) remove the most trees thus the largest reductions in BA post treatments (Table 16). Commercial treatments ICD, CTM and REGEN ST are the only treatments that thin trees to a post treatment basal area < 80 ft^2 and remain less < 80 ft^2 through 2041 on 100% of the treatment acres. ICD and CTM treatments are designed to leave existing clumps with interlocking crowns on up to 8% of the treated area where available. These clumps will have BA's that exceed 80 ft^2.

The RXB and the RXB NF treatments are designed to have small reductions in the over story with high reductions in the understory. The larger trees with added growing space continue to grow adding BA. By 2041 the amount of acres less than 80 ft^2 return to existing levels and there is a 21.4% increase in acres in > than 120 ft^2 (Table 16).

NO TREAT acres in Alternative A promote 91.9% of the forested acres with BA's $\geq$ 120 (59.5% of the forested project area). Overall Alternative A promotes 40.4% $\geq$ 150 BA compare to the No Action Alternative at 68.4% (Table 23). Woody draw treatments would be expected to reduce BA's to less than 80 ft^2 through 2041. PLT acres on the existing forested acres (13) would continue to have BA's > 80 ft^2 where large trees exist. On the new forested acres to be planted (240) BA's would be very low by 2041, about 2 ft^2.

Table 16: Alternative A and No Action – Basal Area Ranges and Average Basal Area per Acre by Percent of Forested Area by Treatment Type by Time Period

Alternative/ Treatment Type		Pre Treat - 2017		Post Treat - 2021		2041	
	Average Basal Area Per Acre Range (BA/ft^2)	Acres	% of Forested Area	Acres	% of Forested Area	Acres	% of Forested Area
A - RXB PP	< 80	19	1.3%	64	4.4%	19	1.3%
	$\geq$ 80 and $\leq$ 120	412	28.1%	1,132	77.2%	82	5.6%
	>120 but < 150	954	65.1%	270	18.4%	1,095	74.7%

Alternative/ Treatment Type		Pre Treat - 2017		Post Treat - 2021		2041	
	Average Basal Area Per Acre Range (BA/ft^2)	Acres	% of Forested Area	Acres	% of Forested Area	Acres	% of Forested Area
	≥150	81	5.5%	0	0.0%	270	18.4%
	Total	**1,466**	**100%**	**1,466**	**100%**	**1,466**	**100%**
A - RXB NF	< 80	24	4.0%	30	5.0%	24	4.0%
	≥ 80 and ≤ 120	186	31.1%	548	91.5%	76	12.7%
	>120 but < 150	387	64.6%	21	3.5%	478	79.8%
	≥150	2	0.3%	0	0.0%	21	3.5%
	Total	**599**	**100%**	**599**	**100%**	**599**	**599**
A - ICD	< 80	0	0.0%	949	100%	949	100%
	≥ 80 and ≤ 120	377	39.7%	0	0.0%	0	0.0%
	>120 but < 150	550	58.0%	0	0.0%	0	0.0%
	≥150	22	2.3%	0	0.0%	0	0.0%
	Total	**949**	**100%**	**949**	**100%**	**949**	**100%**
A – REGEN ST	< 80	0	0.0%	264	100%	264	100%
	≥ 80 and ≤ 120	9	3.4%	0	0.0%	0	0.0%
	>120 but < 150	233	88.3%	0	0.0%	0	0.0%
	≥150	22	8.3%	0	0.0%	0	0.0%
	Total	**264**	**100%**	**264**	**100%**	**264**	**100%**
A - CTM	< 80	0	0.0%	1,468	100%	1,468	100%
	≥ 80 and ≤ 120	21	1.4%	0	0.0%	0	0.0%
	>120 but < 150	1,285	87.6%	0	0.0%	0	0.0%
	≥150	162	11.0%	0	0.0%	0	0.0%
	Total	**1,468**	**100%**	**1,468**	**100%**	**1.468**	**100%**
A – NO TREAT	< 80	348	4.7%	348	4.7%	152	2.1%
	≥ 80 and ≤ 120	2,436	33.0%	2,436	33.0%	441	6.0%
	>120 but < 150	4,482	60.8%	4,482	60.8%	2,191	29.7%
	≥150	112	1.5%	112	1.5%	4,594	62.2%
	Total	**7,378**	**100%**	**7,378**	**100%**	**7,378**	**100%**
A - PLT	< 80	0	0.0%	0	0.0%	0	0.0%
	≥ 80 and ≤ 120	0	0.0%	0	0.0%	0	0.0%
	>120 but < 150	13	100%	13	100%	0	0.0%
	≥150	0	0.0%	0	0.0%	13	100%
	Total	**13**	**100%**	**13**	**100%**	**13**	**100%**
No Action	< 80	391	3.2%	391	3.2%	164	1.4%
	≥ 80 and ≤ 120	3,441	28.3%	3,441	28.3%	508	4.2%
	>120 but < 150	7,909	65.2%	7,909	65.2%	3,160	26%
	≥150	396	3.3%	396	3.3%	8,305	68.4%
	Total	**12,137**	**100%**	**12,137**	**100%**	**12,137**	**100%**

Horizontal - Canopy Cover

Canopy cover is a horizontal structure of forest vegetation that implies density. High canopy cover generally equates to full occupancy or near full occupancy of growing space. When full occupancy occurs or when nutrients, water or light are limited trees have to compete. When competition is high stand and tree vigor can be weakened making them more susceptible to insect and disease attack and prone to wind and snow damage events. High canopy cover can also be a factor for potential fire type. Continuous canopy cover (>40%) is more likely to sustain an active crown fire under certain weather conditions.

ICD, CTM, and REGEN ST have the greatest impact on changing canopy cover from existing (Table 17, and Sandbak, 2018H).

Forested Vegetation ICO Treatments (ICD, CTM, REGEN ST RXB PP, RXB NF, Post-Sale Non-commercial Thinning, and PLT):

ICD and CTM Treatments (Individual Trees/Clumps) – Pretreatment the majority of the ICD areas are <40% canopy cover and CTM >40% (Table 17). Post treatment portions the ICD treatment areas will be less than 10%, due to the desired condition to have widely spaced individual trees. With the desired clumping and understory that will contribute to the canopy cover these will generally average above 10%. The CTM treatment areas in post-treatment has the majority of the canopy cover in the 25-39% class (49.4%), this is due to the desired closer individually spaced trees in the thinned area (see the Threemile Restoration and Resiliency Project Environmental Assessment and Scoping Document (Table 1in the Environmetal Assessment and Table 1 in Scoping Document). In addition the CTM will have 35.0% in less than 10% canopy cover due to the small openings. By 2041 the majority of the acreage in the CTM will be < 40% (53.8%). The ICD treatments will promote 43% with < 40% canopy cover. The desired tree spacing in combination to increased growing space, allows new trees to establish, grow, and create additional canopy cover. The thinned understory in these treatments continues to expand its canopy and adds to the canopy cover.

Pretreatment the existing areas available for retaining clumps will exceed 40% canopy cover and by 2041 many of these retained clumps would be in the 60%+ cover class. Some of these clumps will have a thinned understory adding to the canopy cover. These clumps and thinned areas will promote large trees on the landscape (Table 19).

REGEN ST and CTM Small Opening Treatments (Openings) - Pretreatment these areas are dominated by > 40% canopy cover (Table 17). These treatments are intended to establish a new cohort of ponderosa pine seedlings. Post treatment (2021) canopy cover is reduced to less than 10% and with the designated seed trees casting seed, the areas rapidly recover with seedlings and occupy the growing space post disturbance. By 2041, 51% of the area has a canopy cover in ≥40% class and the remainder <40% (Table 17, Sandbak, 2018J). A similar effect will be seen in the ICD treatments due to increased growing space that can promote new seedling development, all though the intent is not a regeneration treatment but widely spaced individual trees.

RXB PP and RXB NF Treatments (Clumps) - Pretreatment these areas are dominated by <40% canopy (62%). Prescribe fire treatments promote 68.3% of the area in this canopy class (Table 17). With continued stand development by 2041 seventy 64.9% has canopy cover ≥ 40%. In comparison, the No Action Alternative will have 70.4% of the acreage with 40% plus canopy (Table 24, and Sandbak, 2018H).

Post-Sale Non Commercial Thinning in ICD and CTM Thin Treatments (Individual Tree/Clumps) – These treatments are done post-harvest as a means to promote a two story condition. The canopy cover effects are included in the treatment discussion above. Clumps will be maintained where stocking is available and the effects will add to maintaining high canopy cover (>40%) scattered across treatment area (see the Threemile Restoration and Resiliency Project Environmental Assessment and Scoping Document (Table 1 in the Environmetal Assessment and Table 1 in Scoping Document).

No Treatment Areas (Skips/Clumps) – Pretreatment these areas are dominated by canopy covers <40% (66.3%). By 2041, with continued stand growth 65.1% will have a canopy cover ≥40% (Table 17).

PLT – The majority of the acres identified on existing forested sites will be maintained in <40% canopy cover throughout the time period (Table 17). The 240 acres of planting to reforest existing burned areas will be in <10% canopy cover post treatment. By 2041, 20% will be in 10-24.9% and 80% will be in 25-39.9% (Sandbak, 2018H).

WD Treatments (Individual Tree) - Pretreatment all of these are dominated by ponderosa pine. Post treatment with removal of most of the pine the canopy cover drops to <10% heavily dominated by green ash. By 2041, most of the treated areas are expected have a canopy cover of 25-39.9% (modeling in ESP). This is in comparison to the No Action Alternative that will have most of the area in a 40% plus canopy with a much higher presence of ponderosa pine component by 2041 (modeling in similar stands, ESP).

By comparison, in the No Action Alternative the existing condition of canopy cover < 40% pretreatment continues to develop. By 2041, seventy percent of the acreage is 40% and greater with 29.4% in the 60% plus class (Table 24).

Table 17: Alternative A - Acres of Canopy Cover Class by Treatment Type by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	Canopy Cover	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
RXB PP	<10%	0	0.0%	0	0.0%	0%	0	0.0%	0%
	10-24.9%	247	16.9%	343	23.4%	+6.5%	86	5.9%	0%
	25-39.9%	701	47.8%	690	47.1%	-0.7%	430	29.3%	-38.5%
	40-59.9%	458	31.2%	385	26.2%	-5.0%	671	45.8%	22.5%
	60% plus	60	4.1%	48	3.3%	-0.8%	279	19.0%	16.1%
	Sub Totals	**1,466**	**100%**	**1,466**	**100%**		**1,466**	**100%**	
RXB NF	<10%	0	0.0%	0	0.0%	0%	0	0.0%	0%
	10-24.9%	117	19.6%	152	25.4%	+5.8%	38	6.4%	-13.2%
	25-39.9%	217	36.2%	225	37.5%	+1.3%	170	28.5%	-7.7%
	40-59.9%	229	38.2%	193	32.3%	-5.9%	246	41.0%	+2.8%
	60% plus	36	6.0%	29	4.8%	-1.2%	145	24.1%	+18.1%
	Sub Totals	**599**	**100%**	**599**	**100%**		**599**	**100%**	
ICD	<10%	0	0.0%	0	0.0%	0%	0	0.0%	0%
	10-24.9%	103	10.8%	901	94.9%	+84.1%	45	4.7%	+14.6%
	25-39.9%	384	40.5%	3	0.3%	-40.2%	363	38.3%	+71.3%
	40-59.9%	429	45.2%	31	3.3%	-41.9%	482	50.8%	-8%
	60% plus	33	3.5%	14	1.5%	-2.0%	59	6.2%	-3.8%
	Sub Totals	**949**	**100%**	**949**	**100%**		**949**	**100%**	
REGEN ST	<10%	0	0.0%	264	100%	+100%	0	0.0%	0.0%
	10-24.9%	13	5.1%	0	0.0%	-5.1%	5	2.0%	+6.7%
	25-39.9%	78	29.5%	0	0.0%	-29.5%	53	20.0%	+32.2%
	40-59.9%	150	56.8%	0	0.0%	-56.8%	158	60.0%	-35.6%
	60% plus	23	8.6%	0	0.0%	-8.6%	48	18.0%	-3.3%
	Sub Totals	**264**	**100%**	**264**	**100%**		**264**	**100%**	
CTM	<10%	0	0.0%	514	35.0%	+35%	0	0.0%	0%
	10-24.9%	74	5.0%	131	8.9%	+3.9%	26	1.8%	-3.2%

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	Canopy Cover	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
	25-39.9%	417	28.4%	725	49.4%	+21.0%	764	52.0%	+23.6%
	40-59.9%	832	56.7%	83	5.7%	-51.0%	514	35.0%	-21.7%
	60% plus	145	9.9%	15	1.0%	-8.9%	164	11.2%	+1.30%
	Sub Totals	**1,468**	**100%**	**1,468**	**100%**		**1,468**	**100%**	
NO TREAT	<10%	0	0.0%	0	0.0%	0%	0	0.0%	0%
	10-24.9%	1,807	24.5%	1,807	24.5%	0.0%	452	6.1%	-18.4%
	25-39.9%	3,087	41.8%	3,087	41.8%	0.0%	2,127	28.8%	-13.0%
	40-59.9%	2,264	30.7%	2,264	30.7%	0.0%	2,994	40.6%	+9.9%
	60% plus	220	3.0%	220	3.0%	0.0%	1,805	24.5%	+21.5%
	Sub Totals	**7,378**	**100%**	**7,378**	**100%**		**7,378**	**100%**	
PLT	<10%	0	0.0%	0	0.0%	0%	0	0.0%	0%
	10-24.9%	5	40.7%	5	40.7%	0.0%	1	8.1%	-32.6%
	25-39.9%	5	39.2%	5	39.2%	0.0%	7	52.2%	+13.0%
	40-59.9%	3	20.1%	3	20.1%	0.0%	5	35.7%	+15.6
	60% plus	0	0.0%	0	0.0%	0.0%	<1	4.0%	+4.0%
	Sub Totals	**13**	**100%**	**13**	**100%**		**13**	**100%**	

Vertical – Canopy Layers

Canopy layers can have an impact on the potential type of fires. Continuous canopy layers create a ladder type effect for fires burning on the surface to burn up into the crown and potentially become a crown fire. Table 18 displays the acres of canopy layer types by treatments in Alternative A by time period. Single and two story canopy layers have the lowest potential for surface fires burning and jumping into the crowns. Without treatment (NO TREAT acres) stands continue to grow and are maintained throughout the time period by a domination of continuous canopy layers (Table 18). Even with treatment stands will develop additional layers overtime.

Commercial treatment areas have the largest impact on the canopy layers in 2021 (post treatment) as thinning treatments are thinning from below removing the ladder fuels. Small openings have an effect by changing to a single story of new seedlings. Ponderosa pine would tend to become 2 story over time if no disturbances (large or small) occur as all growing space get taken up and limited regen occur. The mid story grows into the upper canopy layer resulting in 2 layers (over story with a limited regeneration layer). Small disturbances (insects, disease, wind/storm events, and low intensity fire) created growing space which promoted the multiple canopy layers in the existing condition. Had fire suppression not occurred over the last 100 years or so, and if high frequency, low intensity fire had been allowed to happen the landscape would be more dominated by two and single story structures.

Forested Vegetation ICO Treatments (ICD, CTM, REGEN ST RXB PP, RXB NF, Post-Sale Non-commercial Thinning, and PLT):

ICD and CTM Treatments (Individual Trees/Clumps) – Pretreatment these areas are dominated by a continuous canopy layer (97.4% and 100%). Post treatment the ICD is dominated by a single canopy layer (80.7%) and the CTM by a single layer (85%) with 15% in a 2 layer condition (Table 18). By 2041 the ICD is dominated by a 2 layer condition (90.7%), and 9.3% in single. The CTM with heavier over story retained is also dominated by a 2 canopy layer condition (85%), with 15% in a 3 story condition. Thinning releases growing space for new trees

to establish and grow, developing another canopy layer. Small areas where clumps are maintained could develop into continuous canopy conditions (up to 8% of the area).

REGEN ST and CTM Small Opening Treatments (Openings) – These areas are like the rest of the existing condition and are dominated by continuous canopy layers (100%). With removal of all but the seed trees the canopy is reduced to a single layer condition. By 2041 the regeneration post treatment and beyond creates a 2 layered canopy condition (Table 18, and Sandbak, 2018H).

RXB PP and RXB NF Treatments (Clumps) - Pretreatment these areas are dominated by continuous canopy layers (98.4% and 96.4%). Post treatment with a focus to reduce the ladder fuels the RXB PP reduces the continuous canopy layers by 68.9% and the RXB NF by 67.5% (Table 18). Together these treatments promote 60.8% of the acres in 2 story and single story post treatment. These treatments by 2041 with mid story development into the upper canopy layers and new age classes' established a 2 layer canopy structure occurs on 45.2% with 54.8% in 3 or more canopy layers. By comparison the No Action Alternative is dominated by continuous canopy layers in 2021 and in 2041 (Table 25, and Sandbak, 2018H). Large trees are promoted, and these RXB treatments create growing space where new age classes are developed increasing canopy layers by 2041.

Post-Sale Non Commercial Thinning in ICD and CTM Thin Treatments (Individual Tree/Clumps) – These treatments will leave up to 100 trees per acre where vigorous trees < 9 inches exist in the understories. The intent of this is to promote some structure diversity across scattered areas of the treatment units. This along with creating clumps would create pockets of 2 canopy layers post treatment which could develop into 3 layers by 2041.

No Treatment Areas (Skips/Clumps) – Pretreatment domination of continuous canopy conditions of 96.4% remains throughout the 24 year time period as stands continue to develop (Table 18). Reduction of to 3.3% in single story acres by 2041 as understories develop in the stands that still have growing space available (Table 18).

PLT – Five percent (13 acres) of the total planted acres will remain in continuous canopy cover where scattered forest cover exists throughout the time period (Table 18, Sandbak 2018H). The remaining 95% of the planted acres (240) will be a single story structure post planting and in 2041 (Sandbak 2018H).

WD Treatments (Individual Tree) - Pretreatment these areas have continuous canopy layers of ponderosa pine, and green ash. With removal of most of the ponderosa pine they become dominated by 2 canopy layers of green ash mix and mix of pine (ESP modeling). Response of green ash and ponderosa pine by 2041 creates 3 or more canopy layers (ESP modeling). In comparison to the No Action by 2041, one hundred percent of the areas would be in a 3 or more canopy layer condition (ESP modeling).

Cumulatively post treatment (2021) Alternative A has 26.5% with a single canopy layer, 8.1% with 2, and 65.4% with 3 or more canopy layers (Table 25, Sandbak, 2018H). By 2041, one percent has a single layer, 29.1% 2 layers, and 69.9% has 3 or more layers. In comparison the No Action in 2021 has 97.3% with continuous layers and 2.7% with a single layer. By 2041, this changes to 0.2% with a single layer, 2.5% with 2 layers and 97.3% with continuous layers

(Sandbak, 2018H), and Table 18). Alternative A promotes 30.1% of the area in 2 or less canopies, while the No Action Alternative promotes 2.7% (Table 25).

Table 18: Alternative A - Acres of Canopy Layer Class for Treatments by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	Canopy Layers[1]	Acres	% Forested Area	Acres	% Forested Area	% Change 2009 - 2019	Acres	% Forested Area	% Change 2009 - 2059
RXB PP	1	24	1.6%	457	31.2%	+29.6%	15	1.0%	-0.6%
	2	0	0.0%	424	28.9%	+28.9%	634	43.2%	+43.2%
	3	0	0.0%	152	10.4%	+10.4%	341	23.3%	+23.3%
	Continuous	1,442	98.4%	433	29.5%	-68.9%	476	32.5%	-65.9%
	Sub Totals	**1,466**	**100%**	**1,466**	**100%**		**1,466**	**100%**	
RXB NF	1	22	3.6%	217	36.1%	+32.5%	5	0.8%	-2.8%
	2	0	0.0%	158	26.4%	+26.4%	280	46.7%	+46.7%
	3	0	0.0%	51	8.6%	+8.6%	125	20.9%	+20.9%
	Continuous	577	96.4%	173	28.9%	-67.5%	189	31.6%	-64.8%
	Sub Totals	**599**	**100%**	**599**	**100%**		**599**	**100%**	
ICD	1	25	2.6%	766	80.7%	+78.1%	88	9.3%	+6.7%
	2	0	0.0%	183	19.3%	+19.3%	861	90.7%	+90.7%
	3	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Continuous	924	97.4%	0	0.0%	-97.4%	0	0.0%	-97.4%
	Sub Totals	**949**	**100%**	**949**	**100%**		**949**	**100%**	
REGEN ST	1	0	0.0%	264	100%	+100%	0	0.0%	0.0%
	2	0	0.0%	0	0.0%	0.0%	264	100%	+100%
	3	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Continuous	264	100%	0	0.0%	-100%	0	0.00%	-100%
	Sub Totals	**264**	**100%**		**100%**		**264**	**100%**	
CTM	1	0	0.0%	1,248	85.0%	+85.0%	0	0.0%	0.0%
	2	0	0.0%	220	15.0%	+15.0%	1,248	85.0%	+85.0%
	3	0	0.0%	0	0.0%	0.0%	220	15.0%	+15%
	Continuous	1,468	100%	0	0.0%	-100%	0	0.0%	-100%
	Sub Totals	**1,468**	**100%**		**100%**		**1,468**	**100%**	
NO TREAT	1	262	3.6%	262	3.6%	0.0%	16	0.3%	-3.3%
	2	0	0.0%	0	0.0%	0.0%	246	3.3%	+3.3%
	3	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Continuous	7,116	96.4%	7,116	96.4%	0.0%	7,116	96.4%	0.0%
	Sub Totals	**7,378**	**100%**	**7,378**	**100%**		**7,378**	**100%**	
PLT	1	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	2	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	3	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Continuous	13	100%	13	100%	0.0%	13	100%	0.0%
	Sub Totals	**13**	**100%**	**13**	**100%**		**13**	**100%**	

[1] Number denotes number of canopy layers. Continuous equals more than 3.

Forest Vegetation – Pine Beetle Hazard

Approximately 99% of existing forest vegetation in Alternative A acreage is in moderate to high hazard for MPB (Table 26). Due to stand conditions (quantity and quality of available hosts); large amounts of mortality could be expected if an outbreak were to occur.

Literature suggests a long term solution to increase resiliency to MPB outbreaks is to change forest structure and composition (Fetig, Gibson, Munson, Negron, 2013). This can be done by creating small to moderate sized openings that will increase mosaics within homogenous landscapes of susceptible hosts. Outbreaks will continue to occur as long as susceptible forests and favorable weather coincide. Creation of age class and density mosaics results in landscapes that are not entirely susceptible at the same time period. Alternative A creates a new age class on about 4.2% of the existing forested project area in multiple small openings ranging in size from ½ to 4 acres size (CTM). Forty seven openings will be created ranging in size from 1.2 to 21.2 acres in size on 2.2% of the forested acres (REGEN ST). No openings will be created that exceed 40 acres. Five different density mosaics will be promoted in Alternative A using Clumps and Individual Tree Thinning prescriptions and prescribed fire on about 39% of the forested project area (Table 19). No treatment (skips) will generally promote the existing condition (TPA >25 and medium and large clumps) on about 61% of the project area. Planting in fire areas will return forest cover and create an additional 240 acres of a new age class. Table 19 displays these treatment variations by percent of existing forested acres and by percent of proposed treatment acres in Alternative A. Implementation of Alternative A will promote various densities of large ponderosa pine on about 93% of the existing forested area. All of these variations of treatments have effects on the hazard ratings for MPB and will be discussed below.

Table 19: Alternative A ICO's- Acres of Treatment Types by Percent of Forested Area and Treatment Acres.

		Individual Trees			Clumps		Skips	Openings (New Age Class)	Promote Large Pine Trees	Promote Return Forest Cover
		ICD	REGEN ST, CTM (Small Openings)	CTM (Thin) Areas	Medium to Large Clumps RXB PP, RXB NF, NT's	Small Clumps, ICD, CTM Thin, PLT Areas	No Treatment	REGEN ST, CTM Small Openings		
Alternative/ Treatment	**RX Acres**	**TPA 1 -10**	**TPA 6 - 10**	**TPA 15-25**	**Clumps > 4+ TPA**	**Clumps 2 – 4 TPA**	**TPA >25**			
RXB PP	1,466				1,466				1,466	
RXB NF	599				599				599	
ICD	949	873				76			949	
REGEN ST	264		264					264		
CTM	1,468		514	884		70		514	884	
No Treatment (NT)	7,378				7,378		7,378		7,378	
PLT	13					13				240
Totals	**12,137**	**873**	**778**	**884**	**9,443**	**159**	**7,378**	**778**	**11,276**	**240**
Percent of Forested Area		**7.2%**	**6.4%**	**7.3%**	**17.0%[1] 77.8%[2]**	**1.3%**	**60.8%[2]**	**6.4%**	**92.9%[2]**	
Percent of Treatment Acres		**18.3%**	**16.3%**	**18.6%**	**43.5%[1]**	**3.3%**	**0%**	**16.3%**	**86.7%[1]**	

[1]Percent do not include No Treatment acres. [2]Percent includes No Treatment Acres.

Forest vegetation composition, size class and horizontal structure (BA/ac) will all have various amounts of change from existing condition as a direct result of implementation of the proposed treatments in Alternative A. These vegetation attributes are important in determining the potential mortality of forest vegetation if an outbreak of mountain pine beetle were to occur. Table 20 and the narrative below displays those effects.

Table 20: Alternative A - Acres of Beetle Hazard by Treatment by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	**Pine Beetle Hazard**	**Acres**	**% Forested Area**	**Acres**	**% Forested Area**	**% Change 2017 - 2021**	**Acres**	**% Forested Area**	**% Change 2017 - 2041**
RXB PP	Low	9	0.6%	9	0.6%	0.0%	9	0.6%	0.0%
	Moderate	1,389	94.8%	1,457	99.4%	+4.6%	78	5.3%	+89.5%
	High	68	4.6%	0	0.0%	-4.6%	1,379	94.1%	+89.5%
	Sub Totals	**1,466**	**100%**	**1,466**	**100%**		**1,466**	**100%**	
RXB NF	Low	2	0.4%	2	0.4%	0.0%	2	0.4%	0.0%
	Moderate	526	87.8%	597	99.6%	+11.8%	98	16.3%	-71.5%
	High	71	11.8%	0	0.0%	-11.8%	499	83.3%	+71.5%
	Sub Totals	**599**	**100%**	**599**	**100%**		**599**	**100%**	
ICD	Low	0	0.0%	901	95.0%	+95.0%	901	95.0%	+95.0%
	Moderate	894	94.2%	0	0.0%	-94.2%	0	0.0%	-94.2%
	High	55	5.8%	48	5.0%	-0.8%	48	5.0%	-0.8%
	Sub Totals	**949**	**100%**	**949**	**100%**		**949**	**100%**	
REGEN ST	Low	0	0.0%	264	100%	+100%	264	100%	+100%
	Moderate	247	93.4%	0	0.0%	-93.4%	0	0.0%	-93.4%
	High	17	6.6%	0	0.00%	-6.4%	0	0.0%	-6.4%
	Sub Totals	**264**	**100%**	**264**	**100%**		**264**	**100%**	
CTM	Low	0	0.0%	1,351	92.0%	+92.0%	514	35.0%	+35.0%
	Moderate	1,461	99.5%	0	0.0%	-99.5%	837	57.0%	-42.5%
	High	7	0.5%	117	8.0%	+7.5%	117	8.0%	+7.5%
	Sub Totals	**1,468**	**100%**	**1,468**	**100%**	**1,468**	**1,468**	**100%**	
NO TREAT	Low	152	2.1%	161	2.2%	+0.1%	9	0.1%	-2.0%
	Moderate	6,381	86.5%	6,372	86.4%	-0.1%	642	8.7%	-77.8%
	High	845	11.4%	845	11.4%	0.0%	6,727	91.2%	+79.8%
	Sub Totals	**7,378**	**100%**	**7,378**	**100%**		**7,378**	**100%**	
PLT	Low	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Moderate	13	100%	13	100%	0.0%	13	100%	0.0%
	High	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Sub Totals		**100%**		**100%**			**100%**	

Forested Vegetation ICO Treatments (ICD, CTM, REGEN ST RXB PP, RXB NF, Post-Sale Non-commercial Thinning, and PLT): Individually these treatments have different effects on beetle hazard post treatment (Table 20). The REGEN ST treatments have the largest reduction in beetle hazard due to having conditions less susceptible. Thinning treatments and no treatment areas that promote large trees and higher densities maintain and create susceptible host conditions. Majority of acreage in these treatments pretreatment (2017) are in moderate hazard.

ICD and CTM Treatments (Individual Trees/Clumps) – Thinning from below alters the susceptible host enough to change hazard ratings as BA's are reduced (quantity). Quantity (high BA) and quality (size $\geq$ 8 inches) of the susceptible host are not altered enough to change the hazard ratings in retained clumps. ICD treatments have a larger impact on hazard. Post treatment on the ICD areas 95% of the high hazard is reduced to low hazard (Table 20 and Sandbak, 2018H). Five percent of the area where clumps will be retained will have a high hazard. These hazard levels remain in 2041. Leaving more trees (quantity and quality) and having small openings post treatment in the CTM treatments reduces initially beetle hazard to low by moving 92% of the moderate hazard to low hazard. Eight percent of the area where clumps will be retained will promote a high hazard. However these CTM treatments by 2041, fifty seven percent bumps into a moderate hazard and with 8% still in high hazard. Thinning has been documented to reduce levels of mortality in ponderosa pine when basal areas were thinned to 45 to 85ft^2/acre (Fettig, et al, 2013). Thinning improves tree vigor and alters microclimate, which has been shown to reduce mortality from MPB outbreaks (Fettig, et al 2013). Thinning from below optimizes the effects of microclimate and decreases the ability of the beetle from finding, selecting and colonizing the host. Thinning increases growing space to enhance tree vigor of the residual trees, which strengthens the insect resistance mechanisms. It is anticipated that if an outbreak were to occur less mortality would be expected as a result from the thinning effects. This reduced mortality effect would occur on these ICD and CTM treated acres.

REGEN ST and CTM Small Opening Treatments (Openings) – This treatment has the largest impact at reducing hazard of the ICO treatments by reducing the susceptible host. Quantity (BA) and quality (size) is reduced. The seed trees that remain are still at risk. Post treatment 100% is reduced to a low hazard (Table 20). Small openings on the 35% of the CTM treatments are in low hazard post treatment. By 2041, both of these treatments remain in a low hazard. These are the only ICO treatments that retains 100% of the treatment acres in low hazard from post treatment through 2041.

RXB PP and RXB NF Treatments (Clumps) – Mortality from prescribed fire has a smaller effect on the quantity and quality of the host and post treatment is held at pretreatment conditions of over 99% in the moderate or higher hazard. The only shift is the 7% of high hazard is reduced to moderate (Table 20). By 2041, beetle hazard is high on 91% of the acres. In comparison the No Action in 2041, 94% is high hazard (Table 26).

Post-Sale Non Commercial Thinning in ICD and CTM Thin Treatments (Individual Tree/Clumps) – Post treatment understory thinning is not expected to impact the overall hazard ratings as displayed in the ICD and CTM descriptions above. Depending on the size and location of the potential clumps in relation to the over story and clumps there could be additional areas of 1 to 8% of high hazard post treatment and in 2041.

No Treatment Areas (Skips/Clumps) – Trees continue to grow and increase in quantity (BA) and quality (size). In absence of large disturbances, the susceptible host is not altered enough to change the increase in hazard ratings through the time period. Pretreatment these areas are dominated by moderate/high hazard (97.9%) and by 2041 they are still dominated by high hazard (99.9%).

PLT – The scattered individual trees and small clumps in the 13 acres will remain in moderate hazard throughout the time period. The newly established forest on the 240 acres will not be susceptible to MPB (2021 to 2041).

WD Treatments (Individual Tree) - Woody draw treatments remove all but 10% of the large ponderosa pine (see treatment table Chapter 2). This has an effect on beetle hazard over time. The WD acreage is likely dominated by moderate hazard pretreatment (ESP modeling). Post treatment the hazard drops to low and would be maintained through 2041 (ESP modeling). These individual large trees would still be at risk. In 2041 these acres would be at high hazard in the No Action Alternative.

Cumulatively for these ICO post treatments (2021) Alternative A has 8.3% with a high hazard, 69.5% moderate, and 22.2% low hazard (Table 26). The newly forested 240 acres will have no hazard through the time period. By 2041, seventy two percent has a high hazard, 13.7% a moderate hazard, and 14.0 % low hazard. In comparison the No Action has 8.5% high hazard, 89.9% moderate hazard and 1.6% low hazard. In 2041 high hazard changed to 93.7%, moderate to 6.1% and low to 0.2%. Alternative A promotes about 12% more acres in low hazard than the No Action Alternative in 2041 than that in pretreatment condition on the existing forested acres. (Table 26).

Forest Vegetation - Planting

Planting on 253 acres that currently do not have an adequate seed source in past wildfire areas. The direct effect will be these acres will be reforested and return forest cover on burned areas. Clumps of existing forested areas on the 13 acres will maintain in moderate hazard, while the 240 acres of new seedlings will be in low hazard due to quality and quantity.

Summary of Direct and Indirect Effects

Following is a summary of the direct and indirect effects on the acres treated for the resource indicators as displayed in Table 21:

Pretreatment (2017) to Post Treatment (2021):

- Cover Type – maintain existing ponderosa pine cover on the 4,759 treated with a gain of 240 acres of forest cover in burned areas.
- Size Class – 16.2% gain in initiation of tree class size < .1" and gain of 32.3% in 15" plus size class; corresponding loss in the 5-9.9" and 10 -14.9" class.
- Basal Area per Acre – 57.4% gain in acres having < 80 ft^2.
- Canopy Cover Class – 33.6% reduction in 40% and greater canopy cover and corresponding gain in less than 40%.
- Canopy Layer Class – 81.2% loss in 3 or more canopy layers with gain in 2 or less.
- Beetle Hazard – 52.9% gain in low hazard.
- Planting – 253 acres of planting.

Pretreatment (2017) to 2041:

- Cover Type – maintain existing ponderosa pine cover in the project area with a gain of 240 acres of forest cover in burned areas.

- Size Class – 17.5% gain in tree class size .1 – 4.9" inch and gain of 29.8% in 15" plus size class; corresponding loss in the 5-9.9" and 10 -14.9" class. Gains in small size class due to CTM (small openings) and REGEN ST treatments. Gains in large size class due to intermediate treatments (ICD and CTM) of thinning from below and promoting large trees.
- Basal Area per Acre – 56.3% gain in acres having < 80 ft^2.
- Canopy Cover Class – 7.8% gain in 40% and greater canopy cover and corresponding loss in less than 40%. Gains are due to continued stand development in the intermediate treatments.
- Canopy Layer Class – 69.9% loss in 3 or more canopy layers with gain in 2 or less.
- Beetle Hazard – 35.3% gain in low hazard.
- Planting – 253 acres of planting.

Table 21: Resource indicators and measures for Alternative A – Direct Indirect Effects[1]

Resource Element	Resource Indicator	Existing Acres	% Forested Treatment Acres	Measure (% Change from Existing to Post Treatment 2021)	Measure (% Change from Post Treatment to 2041)
Forested Vegetation Composition - Size Class[1]	<1"	0	0.0%	+16.2%	0.0%
	.1- 4.9"	2	0.1%	0.0%	+17.5%
	5 - 9.9"	111	2.3%	-2.1%	-1.3%
	10- 14.9"	4,510	94.8%	-46.4%	-46.0%
	15" Plus	136	2.8%	+32.3%	+29.8%
		4,759	100%	0.0%	0.0%
Forest Vegetation Structure – Horizontal (Basal Area per acre)[1]	< 80	43	0.9%	+57.4%	+56.3%
	≥ 80 and ≤ 120	1,005	21.1%	+14.2%	-17.8%
	>120 and < 150	3,422	71.9%	-65.5%	-38.8%
	≥150	289	6.1%	-6.1%	+0.3%
		4,759	100%	0.0%	0.0%
Forest Vegetation Structure – Horizontal (Canopy Cover)[1]	<10%	0	0.0%	+16.4%	0.0%
	10-24.9%	559	11.7%	+20.5%	-7.5%
	25-39.9%	1,802	37.9%	-3.3%	-0.3%
	40-59.9%	2,101	44.2%	-29.6%	-0.6%
	60% plus	297	6.2%	-4.0%	+8.4%
		4,759	100%	0.0%	0.0%
Forest Vegetation Structure –Vertical (Canopy Layers)[1]	1	71	1.5%	+60.5%	+0.8%
	2	0	0.0%	+20.7%	+69.1%
	3	0	0.0%	+4.3%	+14.4%
	Continuous	4,688	98.5%	-85.5%	-84.3%
		4,759	100%	0.0%	0.0%
Forest Vegetation – Pine Beetle Hazard[1]	Low	11	0.2%	+52.9%	+35.3%
	Moderate	4,530	95.2%	-51.8%	-73.6%
	High	218	4.6%	-1.1%	+38.3%
		4,759	100%	0.0%	0.0%
Forest Vegetation – Planting[2]	Acres Planted	0	0.0%	+100%	+100%

[1]Acres and % change does not include the 240 acres of currently non forested planting acres.

[2]Acres includes fire areas that are not currently forested (240 acres).

Cumulative Effects

Spatial and Temporal Context for Effects Analysis

The project area encompasses roughly 32,924 acres on the Ashland Ranger District, located in Powder River County, Montana. Further description of the project area can be found in the Threemile Restoration and Resiliency Project Environmental Assessment under Project Area and existing condition above.

The spatial bounds for this forested vegetation analysis is the project boundary for the cumulative effects and the individual treatment areas for direct/indirect effects. This analysis is on forested Forest Service lands based on the inventory and methods discussed above. The project boundary analysis approximates about 12,137 currently forested acres. This project boundary was chosen because it was identified by the ID team initially to capture the forest vegetation effects for the issues identified on the proposed treatment acreage. To demonstrate effects they will be compared against a No Action scenario. Past vegetation management on adjacent private lands is addressed under a discussion of past, present, and reasonably foreseeable future actions.

Direct and indirect effects of the alternatives will be discussed based on the proposed treatment units across the Action Alternatives and the No Action Alternative. Project area effects will be incorporated in the cumulative effects discussion. Measurement will be displayed by pretreatment condition (2017), post treatment conditions (2021) and conditions 20 years from treatment (2041).

The temporal bound is a 24 year time period to capture the direct, indirect, and cumulative effects of the alternatives. This time period will cover initial conditions (2017), post treatment (2021), and 2041. Implementation of activities is expected to begin in 2021. The effects of the proposed activities are projected to last 15 to 100+ years. In general intermediate treatment effects will likely last 15 to 40 years, regeneration treatments would last longer (> 40 years). This time period is based on forest succession data for the habitat types that occur within the proposed treatment area that describes stand development over time (Arno et al, 1985). Natural succession processes would then alter post-treatments stand conditions in the absences of large disturbances or additional vegetation management. Succession processes include increased height growth of understory components (increased canopy layers), ingrowth of ponderosa pine seedlings, expansion of crowns and tree diameters, and individual tree mortality. The temporal bounds for past vegetation management activities for the cumulative effects is limited to the 1980's by the availability of accurate past data.

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

Past

All of the past vegetation management activities since 1983 listed above in the existing conditions occurred prior to the date stamp of the forest's vegetation data set used (VMap) and field sampling. Existing conditions incorporate forest vegetation effects from these activities. Incidental dispersed recreation activities (i.e. campsites), structure improvements for range (i.e. fence line clearing), road maintenance (i.e. edge clearing), treatment of activity fuels (piling and rearrangement of fuels), and road decommissioning may have had minimal localized effects such as removal of individual trees or damage resulting in mortality.

Past prescribed burning from 1983 to 1988 (294 acres) that occurred in the forest and non-forest setting occurred long enough ago that effects are no longer discernable or forest cover is no longer present due to recent wildfires. More recent broadcast burning in 2010 and 2012 (2,334 acres) altered both understory and over story trees in a mosaic pattern across the burn perimeters (Yeager, 2018B). These prescribed

burns created understory mortality from 40 to 80% across about 70 to 80% of the acreage. Over story mortality (direct and indirect) detected on VMap in these treatment areas indicates areas with up to 83% mortality. Majority of the forested area experienced less than 20% over story mortality, with 16% showing 21 to 40%. Less than 3% indicated mortality greater than 40%. Prescribed fire comprised the majority of forested vegetation treatments since 1983. These effects are incorporated in the existing data sets.

Fuels and precommercial thinning in the understory (generally less than <8" in diameter) was done to reduce ladder fuels and/or create a fuel bed. This occurred in 2009, 2010 and 2011 across about 4,270 acres. This activity occurred generally along roads, along perimeters and scattered pockets. Less than 15% of the acreage was effected by treatment activity.

A liberation harvest occurred in 1989 to remove over story and release the understory trees on 235 acres. Post-sale timber stand improvement activities thinned the understory. Multiple wildfires from 2000 to 2012 burned over these treated areas and have since removed most of the forest cover (Yeager, 2018A, 2018C, and 2018D).

Planting of ponderosa pine occurred on 54 acres within the 2012 wildfire and has since been certified stocked according the forests stocking goals (Table 13).

Vegetation treatments prior to 2000 have very little cumulative effect on vegetation structure that changes overall susceptibility to outbreaks of MPB or potential crown fire types within the project area due to length of time since treatment or these areas have been burned over and forest cover has been removed. Approximately 24% of the existing forest vegetation has had recent treatments, confined to the southern half of the project area. These treatments have altered the forest vegetation structure and are incorporated in the existing condition. The effects of these treatments are those defined in the action and no action alternatives. Incidental non vegetation treatments discussed above are expected to continue and have minimal effects on the forest vegetation.

Wildfires from 2000 to 2016 have had an 11,188 acre foot print within the project area, predominantly on the northern half of the project area. These fires had a direct impact on forest cover due to the fire behavior experienced and areas burning in multiple fire events (Yeager, 2018B). Scattered pockets of ponderosa pine cover in the northern portion remain today (Yeager, 2018C). These fires are slowly reforesting where seed source is available across 3,414 acres (USDA, 2014). Approximately five hundred acres have no seed source and are on dry aspects that will take several decades for forest cover to return. About 253 acres are on moist aspects that are lacking an adequate seed source to restock to the forests stocking objectives.

A prescribe burn escaped onto adjacent private property in 2009 (~235 acres) with the same effects as described above on Forest Service lands. A commercial thinning occurred on private lands during the early to mid 2000's; actual acres and date of implementation are unknown. These are intermediate treatments and effects to the forest vegetation structure and susceptibility to MPB are those as described above for existing condition within the project area.

Present

Present forest vegetation management activities in the Threemile project area include aggressive wildland fire suppression, incidental non vegetation activities, and very limited personal use firewood cutting Except for wildland fire suppression these activities will not in themselves alter forest vegetation composition and structure at discernable levels at the project level. Wildland fire suppression may eliminate or limit the size of fire disturbance and stand succession will continue with changes in forest

stand structure that are at higher risk for insect outbreaks and potential crown fire as described above. A large disturbance (wildfire or insect outbreak) could result in large amounts of mortality and alter the forest vegetation.

Reasonably Foreseeable Future

Activities described above under present activities are considered to continue at the same levels and are considered in the cumulative effects assessment. Except for wildland fire suppression as described above in the present activities these in themselves would not have discernable effects at the project level. No other forest vegetation activities are anticipated in the reasonably foreseeable future. Wildfire areas on the northern half of the project areas are expected to continue reestablishment of forest cover. A potential larger cumulative impact in the past wildfire areas would be a reburn that could alter or remove the recovering forest cover.

Forest Vegetation Composition (Size Class and Age)

Thinning increases growing space, promoting individual tree growth (diameter), Alternative A has a net increase (+11.6%) in the largest diameter size class compared to the No Action Alternative. Thinning from below and prescribed burning to reduce the understory components leaves the larger trees that in addition have an influence in the increase of acres in the large tree size class. Alternative A promotes large trees on the landscape. In 2021 (post treatment), 14% of the forested acres will be size classes 15"+, in comparison to the No Action Alternative of 1.4% (Table 22). Alternative A post treatment promotes more acreage in the large tree class (1,582 vs. 167) than the No Action Alternative.

Table 22: Alternative A and No Action - Acres of Size Class by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Alternative	Diameter Class (Inches)[1]	Acres	% Forested Acres	Acres	% Forested Acres	% Change 2017 - 2021	Acres	% Forested Acres	% Change 2017 - 2041
A	<.1"	0	0.0%	771	6.3%	+6.3%	0	0.0%	0.0%
	.1- 4.9"	21	0.2%	21	0.2%	0.0%	854	7.0%	+6.8%
	5 - 9.9"	653	5.4%	553	4.6%	-0.8%	593	4.9%	-0.5%
	10- 14.9"	11,296	93.1%	9,088	74.9%	-18.2%	9,108	75.1%	-18.0%
	15" Plus	167	1.4%	1,704	14.0%	12.6%	1,582	13.0%	+11.6%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	
No Action	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	21	0.2%	21	0.2%	0.0%	21	0.2%	0.0%
	5 - 9.9"	653	5.4%	653	5.4%	0.0%	653	5.4%	0.0%
	10- 14.9"	11,296	93.1%	11,296	93.1%	0.0%	11,296	93.1%	0.0%
	15" Plus	167	1.4%	167	1.4%	0.0%	167	1.4%	0.0%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	

In 2021, Alternative A has all 5 size classes represented (<.1", .1 – 4.9, 5-9.9", 10'-14.9", 15"+) with 6.3% in the <.1" class, .2% in the .1-4.9" class, 4.6% in the 5-9.9" class, 74.9% in the 10-14.9" class, and 14% in the 15" + class. The small size classes represented in Alternative A is due to the REGEN ST and CTM small opening treatments that initiated a new age class. In comparison the No Action Alternative

has 4 size classes represented (.1 – 4.9, 5-9.9", 10'-14.9", 15"+) with 93.1% in the 10-14.9" class (Table 22).

Post treatment (2021), Alternative A promotes more acreage in the large tree class than the No Action Alternative and has more size classes represented. By 2041, both Alternative A and the No Action have 4 size classes. The No Action has about 6.8% less acreage in the 5-9.9" size class than Alternative A. The No Action Alternative has less diversity in the size class representation than the Action Alternative with 93.1% in the one size class (10 – 14.9").

Alternative A initiates 778 acres of a new age class (6% of forested acres in the project area) through implementation of the treatments on existing forested acres. An additional 240 acres will be planted to increase forested acres. The No Action Alternative will not add a new age class on existing forested acres. Both alternatives will increase forest cover and add a new age class as the wildfire areas slowly reestablish in the northern part of the project area.

Forest Vegetation Structure – Horizontal (Basal Area/Acre and Canopy Cover) and Vertical (Canopy Layers).

Horizontal - Basal Area

Basal area per acre (in combination with diameter) is an important attribute in determining potential hazards for the insect of concern (MPB). Eighty square feet per acre and QMD's $\geq$ 6 " is the break between a low hazard rating and moderate hazard rating for MPB (see interpreting MPB hazard above). Acres of average BA ranges for Alternative A and the No Action Alternative by time period are displayed in Table 23. Pretreatment acres for Alternative A has 96.8% of the acres $\geq$ 80 ft^2. Post treatment Alternative A has 25.7% of the acres < 80ft^2, the No Action has 3.2%. By the end of the 24 year period there are 9,261 acres (76.3%) $\geq$ 80ft^2 in Alternative A. By comparison the No Action alternative has 96.8% of the acres in 2021 and in 2041 has 98.6% in BA's $\geq$ 80ft^2.

Table 23: Alternative A and No Action Cumulative Effects – Basal Area Ranges and Average Basal Area per Acre by Percent of Forested Area by Time Period

Alternative		Pre Treat - 2017		Post Treat - 2021		2041	
	Average Basal Area Per Acre Range (BA/ft^2)	Acres	% of Forested Area	Acres	% of Forested Area	Acres	% of Forested Area
A	< 80	391	3.2%	3,122	25.7%	2,876	23.7%
	$\geq$ 80 and $\leq$ 120	3,441	28.3%	4,116	33.9%	599	4.9%
	>120 but < 150	7,909	65.2%	4,786	39.5%	3,763	31.0%
	$\geq$150	396	3.3%	113	0.9%	4,899	40.4%
	Total	**12,137**	**100%**	**12,137**	**100%**	**12,137**	**100%**
No	< 80	391	3.2%	391	3.2%	164	1.4%
	$\geq$ 80 and $\leq$ 120	3,441	28.3%	3,441	28.3%	508	4.2%
	>120 but < 150	7,909	65.2%	7,909	65.2%	3,160	26%
	$\geq$150	396	3.3%	396	3.3%	8,305	68.4%
	Total	**12,137**	**100%**	**12,137**	**100%**	**12,137**	**100%**

Horizontal - Canopy Cover

Canopy cover is a horizontal structure of forest vegetation that implies density. High canopy cover generally equates to full occupancy or near full occupancy of growing space. When full occupancy occurs or when nutrients, water or light are limited trees have to compete. When competition is high stand and tree vigor can be weakened making them more susceptible to insects and disease attack and prone to wind and snow damage events. High canopy cover can also be a factor for potential fire type. Continuous canopy cover (>40%) is more likely to sustain an active crown fire under certain weather conditions. Table 24 displays the acres of canopy cover class by Alternative A and the No Action Alternative by time period.

Table 24: Alternative A and No Action Cumulative Effects - Acres of Canopy Cover Class by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Alternative	Canopy Cover	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
A	<10%	0	0.0%	778	6.4%	+6.4%	0	0.0%	0.0%
	10-24.9%	2,368	19.5%	3,341	27.5%	+8.0%	653	5.4%	-14.1%
	25-39.9%	4,888	40.3%	4,734	39.0%	-1.3%	3,915	32.2%	-8.1%
	40-59.9%	4,364	36%	2,959	24.4%	-11.6%	5,070	41.8%	+5.8%
	60% plus	517	4.2%	325	2.7%	-1.5%	2,499	20.6%	+16.4%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	
No Action	<10%	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	10-24.9%	2,368	19.5%	2,368	19.5%	0.0%	592	4.9%	-14.6%
	25-39.9%	4,888	40.3%	4,888	40.3%	0.0%	3,000	24.7%	-15.6%
	40-59.9%	4,364	36%	4,364	36%	0.0%	4,975	41.0%	+5.0%
	60% plus	517	4.2%	517	4.2%	0.0%	3,570	29.4%	+25.2%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	

Post treatment (2021) Alternative A has 27.1% in 40% plus canopy and by 2041, 62.4% of project forested acreage in 40% plus. The No Action has 40.2% in 2021 and 70.4% in a canopy cover greater than 40% by 2041. By 2041, Alternative A promotes 22.2% and the No Action 30.2% forested acres with 40% plus canopy from the existing condition.

Vertical – Canopy Layers

Canopy layers can have an impact on the potential type of fires. Continuous canopy layers create a ladder type effect for fires burning on the surface to burn up into the crown and potentially become a crown fire. Table 25 displays the acres of canopy layer types by Alternative A and the No Action Alternative by time period. Single and two story canopy layers have the lowest potential for surface fires burning and jumping into the crowns. Without treatment (No Action Alternative) stands continue to grow and are maintained throughout the time period by a domination of continuous canopy layers (Table 25). Even with treatment stands will develop additional layers overtime.

With treatments in Alternative A stands are less dominated by continuous canopy layers post treatment and through 2041. Post treatment 65.4% of the acres will have 3 or more canopy layers and by 2041, 69.9% will exhibit 3 or more layers (Table 25). In comparison under the No Action Alternative, 97.3% in

both 2021 and 2041 will have 3 or more canopy layers (Table 25). Additional disturbances beyond 2041 to remove new developing layers would need to occur to maintain less multi canopy conditions.

Table 25: Alternative A and No Action Cumulative Effects - Acres by Canopy Layers by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Alternative	Canopy Layers[1]	Acres	% Forested Area	Acres	% Forested Area	% Change 2019 - 2021	Acres	% Forested Area	% Change 2017 - 2041
A	1	332	2.7%	3,213	26.5%	+23.8%	124	1.0%	-1.7%
	2	0	0.0%	986	8.1%	+8.1%	3,532	29.1%	+29.1%
	3	0	0.0%	203	1.7%	+1.7%	686	5.7%	+5.7%
	Continuous	11,805	97.3%	7,735	63.7%	-33.6%	7,795	64.2%	-33.1%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	
No	1	332	2.7%	332	2.7%	0.0%	23	0.2%	-2.5%
	2	0	0.0%	0	0.0%	0.0%	309	2.5%	+2.5%
	3	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Continuous	11,805	97.3%	11,805	97.3%	0.0%	11,805	97.3%	0.0%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	

[1] Number denotes number of canopy layers. Continuous equals more than 3.

Forest Vegetation – Pine Beetle Hazard

Forest vegetation composition, size class and horizontal structure (BA/ac) will all have various amounts of change from existing condition as a direct result of implementation of the proposed treatments in Alternative A. Cumulatively across the project areas these effects are lessened. These vegetation attributes are important in determining the potential mortality of forest vegetation if an outbreak of mountain pine beetle were to occur. Alternative A reduces moderate/high beetle hazards to varying degrees. Pretreatment 8.8% of the forested acreage is in high hazard, 89.9% is in moderate hazard. Post treatment (2021), high hazard drops to 8.3%, moderate drops to 69.5%, and 22.2% is now in a low hazard. By 2041, high hazard is at 72.3%, moderate at 13.7% and the low is at 14%. In comparison the No Action has 8.5% in high hazard and 89.9% in moderate hazard in 2021. By 2041 high hazard is 93.7% and moderate is 6.1%. Table 26 below displays by Alternative A and the No Action Alternative the acres and percent of acres in each hazard and then compares the acres and percent change from existing conditions for post treatment and in 2041 (Sandbak, 2018H).

Table 26: Alternative A and No Action Cumulative Effects - Pine Beetle Hazard Rating by Time Period and Percent Change.

		Pre Treat - 2017		Post Treat - 2021			2041		
Alternative	Pine Beetle Hazard	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
A	Low	164	1.3%	2,688	22.2%	+20.9%	1,700	14.0%	+12.7%
	Moderate	10,910	89.9%	8,439	69.5%	-20.4%	1,668	13.7%	-76.2%
	High	1,063	8.8%	1,010	8.3%	-0.5%	8,769	72.3%	+63.5%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	

		Pre Treat - 2017		Post Treat - 2021			2041		
Alternative	Pine Beetle Hazard	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
No Action	Low	164	1.3%	192	1.6%	+0.3%	29	0.2%	-1.1%
	Moderate	10,910	89.9%	10,918	89.9%	0.0%	746	6.1%	-83.8%
	High	1,063	8.8%	1,027	8.5%	-0.3%	11,362	93.7%	+84.9%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	

The No Action Alternative has the largest amount of acres in the moderate and high hazard ratings post treatment to 2041 (Table 26). By 2041 there is an 84.9% increase in the high hazard and an 83.8% decrease in moderate hazard, with 93.7% rated as high. About ninety nine percent of the landscape without treatment or disturbance could experience high amounts of mortality if an outbreak were to occur and weather conditions are conducive to the mountain pine beetle from 2017 to 2041.

Alternative A creates acres in a low hazard and reduces the amount of acres in the moderate and high hazard, most notably post treatment (Table 26). Compared to the No Action Alternative, Alternative A has the greatest amount of change in hazard ratings through the 24 year time period. Compared to existing conditions (2017), low hazard rating increases by 20.9%, high hazard acreage decreases by 0.5%, and moderate hazard decreases by 20.4% post treatment. Post treatment 8.3% occurs in high hazard. By 2041 in comparison to pretreatment conditions, low hazard increases by 12.7%, moderate decreases by 76.2% and high hazard increases by 63.5%. Ninety nine to eighty six percent of the landscape could experience high amounts of mortality if an outbreak was to occur and weather conditions are conducive to the mountain pine beetle from 2017 to 2041.

In comparison the No Action Alternative, hazard ratings continue to increase in the high hazard, with <2% hazard rating below moderate through the 24 year time period (Table 26). By 2041, moderate hazard decreases by about 84% with a corresponding increase in high hazard from pretreatment conditions.

Alternative A reduces the amount of acres that could experience large mortality if an outbreak of MPB were to occur over that in the No Action Alternative by maintaining a higher amount of acreage in low hazard over the post treatment time period (2021 to 2041). Compared to the No Action Alternative (from post treatment to 2041) 78 to 86% of project forested acres after implementation of Alternative A acres could experience a high amount of mortality if an outbreak were to occur, which is a 20.6% to 13.8% decrease from the No Action Alternative. Alternative A promotes about 12% less acres in mod/high than the No Action Alternative in 2041 than that in pretreatment condition.

Forest Vegetation - Planting

Planting on 253 acres that currently do not have an adequate seed source in past wildfire areas. In comparison to the No Action Alternative there will be no reforesting of these areas and stocking would be delayed for several decades.

Conclusion

The percent change in forest composition and structure are a function of the acres treated in the Alternative A and forest succession over the 24 year period. The direct and indirect effects to forest vegetation structure and composition attributes are discussed in the above sections on about 4,759 treatment acres (cover type, size class, canopy cover and canopy layers) the cumulative effects at the project level changes in acres (~12,137 existing forested acres and ~240 existing non forested acres) are discussed above and summarized below for changes in 2 time periods pretreatment to post treatment and pretreatment to 2041. Additional treatments or more aggressive treatments would need to occur to affect landscape level changes that would last longer. Summary Table 27 is below and available in the project record (Sandbak, 2018H).

Pretreatment (2017) to Post Treatment (2021):

- Cover Type – maintain existing ponderosa pine cover in the project area with a gain of 240 acres of forest cover in burned areas.
- Size Class – 6.3% gain in initiation of tree class size < .1" and gain of 12.6% in 15" plus size class; corresponding loss in the 5-9.9" and 10 -14.9" class.
- Basal Area – 22.5% gain in acres with basal area less than 80 ft^2.
- Canopy Cover Class – 13.1% reduction in 40% and greater canopy cover and corresponding gain in less than 40%.
- Canopy Layer Class – 31.9% loss in 3 or more canopy layers with gain in 2 or less.

Pretreatment (2017) to 2041:

- Cover Type – maintain existing ponderosa pine cover in the project area with a gain of 240 acres of forest cover in burned areas.
- Size Class – 6.8% gain in tree class size .1 – 4.9" inch and gain of 11.7% in 15" plus size class; corresponding loss in the 5-9.9"and 10 -14.9" class. Gains in small size class due to CTM (small openings) and REGEN ST treatments. Gains in large size class due to intermediate treatments (ICD and CTM) of thinning from below and promoting large trees.
- Basal Area – 20.5% gain in acres with basal area less than 80 ft^2.
- Canopy Cover Class – 22.2% gain in 40% and greater canopy cover and corresponding loss in less than 40%. Gains are due to continued stand development in the untreated areas and in the intermediate treatments.
- Canopy Layer Class – 27.4% loss in 3 or more canopy layers with gain in 2 or less.

Beetle Hazard

Cumulative effects from the proposed treatments at the project area (4,759 across 12,137 forested acres) on MPB hazards are small, because like the existing forest vegetation conditions in the treatment units the majority of acres are in a moderate and high hazard by 2041. Existing condition (2017) has 8.8% of the project area in high and 89.9% in moderate hazard. Alternative A decreases high by 0.5%, decreases moderate by 20.4% and gains 20.9% in low hazard from existing to post treatment (2021). By 2041 the cumulative effects from the Alternative A treatments and continued stand development increases high by 63.5%, decreases moderate by 76.2% and increases 12.7% in low hazard. In comparison, the No Action Alternative existing hazard conditions are mostly maintained in 2021. From 2017 to 2041 stand development under the No Action increases high hazard by 84.9% and reduces moderate and low hazard

by that amount (Table 26). Table below summarizes changes in beetle hazard with implementation of Alternative A.

Assuming no large disturbances occur at the project level, treatment effects to forest vegetation has cumulative effects for beetle hazard as described above. The effectiveness of treatments is only realized in treated stands. Additional acres of treatments or more aggressive treatments (like REGEN ST, CTM small openings, and ICD) would need to occur to maintain treatment effects at reducing beetle hazard longer term or the extent at the project landscape.

Table 27: Resource indicators and Measures for Alternative A – Cumulative Effects

Resource Element	Resource Indicator	Existing Acres	% Forested Area	Measure (% Change from Existing to Post Treatment)	Measure (% Change from Post Treatment to 2041)
Forested Vegetation Composition - Size Class	<1”	0	0.0%	+6.3%	0.0%
	.1- 4.9"	21	0.2%	0.0%	+6.8%
	5 - 9.9"	653	5.4%	-0.8%	-0.5%
	10- 14.9"	11,296	93.1%	-18.1%	-18.0%
	15” Plus	167	1.4%	+12.6%	+11.7%
Forest Vegetation Structure – Horizontal (Basal Area per acre)[1]	< 80	391	3.2%	+22.5%	+20.5%
	≥ 80 and ≤ 120	3,441	28.3%	+5.6%	-23.4%
	>120 and < 150	7,909	65.2%	-25.7%	-34.2%
	≥150	396	3.3%	-2.4%	+37.1%
Forest Vegetation Structure – Horizontal (Canopy Cover)[1]	<10%	0	0.0%	+6.4%	0.0%
	10-24.9%	2,368	19.5%	+8.0%	-14.1%
	25-39.9%	4,888	40.3%	-1.3%	-8.1%
	40-59.9%	4,364	36.0%	-11.6%	+5.8%
	60% plus	517	4.2%	-1.5%	+16.4%
Forest Vegetation Structure –Vertical (Canopy Layers)[1]	1	332	2.7%	+23.8%	-1.7%
	2	0	0.0%	+8.1%	+29.1%
	3	0	0.0%	+1.7%	+5.7%
	Continuous	11,805	97.3%	-33.6%	-33.1%
Forest Vegetation – Pine Beetle Hazard[1]	Low	164	1.3%	+20.9%	+12.7%
	Moderate	10,910	89.9%	-20.4%	-76.2%
	High	1,063	8.8%	-0.5%	+63.5%
Forest Vegetation – Planting[2]	Acres Planted	253	0.0%	+100%	+100%

[1]Acres and % change does not include the 240 acres of currently non forested planting acres.

[2]Acres includes fire areas that are not currently forested (240 acres).

No Action Alternative

There is approximately 12,137 acres of existing forested acres, the same acres as modeled in the Action Alternatives. Changes within individual units, strata types and treatment types are in the project record (Sandbak, 2018H and 2018I).

Trees will continue to grow and barring large disturbances for the next 40 years forest vegetation composition size class, age class, horizontal structure and vertical structure will change. How they

change is dependent on site conditions and current forest vegetation conditions. Under this alternative no forest vegetation management is proposed and cumulative effects are evaluated based on no large disturbance events taking place. Wildfire suppression will continue.

For the project area (12,137 acres) the existing conditions (2017) were described above. Generally the same trends occur in forest vegetation composition, size class, forest structure (both vertical and horizontal), and insect hazards as describe above in the direct and indirect effects for the 24 year time period on the no treated areas. The difference is on scale and the homogeneity of the forest vegetation conditions across 12,137 acres. In general, canopy cover (horizontal structure) in the greater than 40% class increases by 30.2% by 2041. Canopy layers (vertical structure) in the continuous canopy layer class stays the same with the existing single story moving to two story condition by 2041. As small disturbances happen and open canopies up, multi layers can develop. Within these small scale disturbances two story conditions can also develop. Changes in forest vegetation conditions (forest composition, size class, and age class and forest structure) at the project level are documented in the project record (Sandbak, 2018H, 2018I, and 2018J). With continued stand succession the No Action Alternative has an effect on the hazard ratings of beetles from 2017 to 2041. Acres and percent of the project acres by beetle hazard are displayed in Table 34. Of importance are the trends and the percent of acreage in the insect hazard ratings that could result in large mortality. As in Alternative A the greatest threat for large mortality if an outbreak were to occur is from the MPB.

Forest Vegetation Composition (Size Class and Age)

Species dominance will remain ponderosa pine with small inclusions of woody draws as described in the existing condition above. Large fires in the southern part of the project area that result in high mortality could create additional acreages of non-forested areas as experienced in the northern part of the project area. Ponderosa pine forest cover is expected to slowly increase in acres as seedlings slowly begin reestablishing in these past fire areas across approximately 4,241 acres (USDA, 2014).

Stand age and age ranges described in the existing conditions above are anticipated to change incrementally in ages for 2021 and 2041, barring any major disturbance. Individual old trees and small areas identified as old growth will have continued presence on the landscape, however natural mortality (i.e. age related and bark beetle attack) will continue to take out individual trees as observed in the field inventories (field inventory available in project record).

Trees will continue to grow, however size class representation is not anticipated to change much barring any large disturbances for the analyzed time period (2017 to 2041). The existing forested stands are generally densely stocked and experiencing low growth rates due to competition. There will be small disturbances occurring dependent on site conditions and current forest vegetation conditions that may change individual tree diameters, but not enough to alter measurable amounts from existing condition of represented size classes. The Table 28 demonstrates the anticipated size classes in the temporal period for the analysis.

Approximately 93% of the forested acreage will be maintained in the 10-14.9” class across the temporal analysis period. The current landscape is limited in size class diversity with only 5.4% in the 5-9.9” class, 0.2% in the 15” plus class, and less than 1% in the .1-4.9” class. There are no existing forested acres represented in the <0.1” size class. As past fire areas begin to establish with seedlings, new forested acres will move into the seedling class.

Table 28: No Action - Acres and Percent of Acres by Diameter Class (Successional Stage) by Time Period.

	Pre Treat - 2017		Post Treat - 2021		2041	
Diameter Class (Inches)[1] and Successional Stage	**Acres**	**% Forested Area**	**Acres**	**% Forested Area**	**Acres**	**% Forested Area**
<.1" (Seedlings < 4.5")	0	0.0%	0	0.0%	0	0.0%
.1- 4.9" (Saplings)	21	0.2%	21	0.2%	21	0.2%
5 - 9.9" (Pole)	653	5.4%	653	5.4%	653	5.4%
10- 14.9" (Mature/Over mature)	11,296	93.1%	11,296	93.1%	11,296	93.1%
15" Plus (Mature/Over mature)	167	1.4%	167	1.4%	167	1.4%
Sub Totals	**12,137**	**100%**	**12,137**	**100%**	**12,137**	**100%**

[1]Diameter at 4.5 feet.

Forest Vegetation Structure – Horizontal (Basal Area/Acre and Canopy Cover) and Vertical (Canopy Layers).

In the No Action treatment stands will continue to grow and trees will die and individual trees will reestablish. Horizontal structure (or density of trees) will be displayed in this section for basal area, and canopy closure to show how density changes over the 24 year time period without a major disturbance event.

As small disturbances (insects, weather, and competition) take place and trees die open growing spaces are created and new trees regenerate. New trees will establish and grow underneath the canopy (ingrowth), but will be slow to grow as ponderosa pine needs sunlight to grow at full potential. Ingrowth especially when growing under canopies result in 2 or more canopy layers. Table 29 indicates existing average trees per acre ranges. Trees per acre are expected to have increases as trees continue to fill in from small disturbances (insects, wind, snow, competition, age) and lower canopied stands where growing space is still available. High TPA reduces available growing space and reduces the vigor of individual trees. Modeling in these pine types for a 20 year period generally shows a 35% increase in stocking (ingrowth) where growing space is still available (small disturbance areas and low canopy cover) and under high canopied stands the small diameter trees generally decrease by an average of 13% related to competition (ESP modeling and USDA, 2016B). Average trees per acre by strata type and sampled stands can be found in the project record (Field inventory in project record; Sandbak, 2018C, 2018D, and 2018G).

Table 29: Average Trees per Acre and Range for Existing Forested Area

Pre Treat 2017	
TPA Range	**Acres**
130-3,375	**12,137**

Basal area (BA) is another way to display density or horizontal structure. BA is the cross sectional measurement of a tree generally expressed in square feet per acre. Basal area is correlated to trees per acre and size of trees. Small diameter trees have a low BA, while large diameter trees have a higher BA. Many small diameter trees on a per acre basis can have the same BA as a few large trees. Average BA/ac varies across the units based on aspect and existing tree size and densities. Individual BA/ac by sampled units is in the project record (Sandbak, 2018C and 2018D). An average BA / ac range by time period is displayed in Table 30 with a range of 62 to 208 across the time periods. This density attribute is important for things like insect hazard because in combination with diameter of trees insect hazard varies. BA and effects on bark beetles is discussed above.

The range of BA/acre increases over the 24 year period as trees are growing and increasing in diameter. Low BA/acre is attributed to dryer sites, lower stocked sites, and grassland dominated sites. The higher end of the range is stands that are greater than 10.0" diameter and greater than 40% canopy cover class.

Table 30: No Action - Average Basal Area (Square Feet) per Acre and Ranges by Time Period

Pre Treat- 2017		Post Treat - 2021		2041	
Average Basal Area Per Acre Range	Average Basal Area Per Acre	Average Basal Area Per Acre Range	Average Basal Area Per Acre	Average Basal Area Per Acre Range	Average Basal Area Per Acre
62 - 166	124	62 - 166	124	77 - 208	155

The table below indicates that 65.2% of the existing forested acreage has greater than 120 square feet of basal area per acre but less than 150. Only 3.3% has basal area 150 or greater. By 2041, 94% of the forested area will have a basal area greater than 120, 68.4% 150 or greater. Basal area less than 80 makes up 1.4% of the forested acres by 2041, a 1.8% decrease from existing.

Table 31: No Action - Basal Area Ranges and Average Basal Area per Acre by Percent of Forested Area by Time Period

	Pre Treat - 2017		Post Treat - 2021		2041	
Average Basal Area Per Acre Range(BA/ft^2)	Acres	% of Forested Area	Acres	% of Forested Area	Acres	% of Forested Area
< 80	391	3.2%	391	3.2%	164	1.4%
≥ 80 and ≤ 120	3,441	28.3%	3,441	28.3%	508	4.2%
>120 but < 150	7,909	65.2%	7,909	65.2%	3,160	26%
≥150	396	3.3%	396	3.3%	8,305	68.4%
Total	**12,137**	**100%**	**12,137**	**100%**	**12,137**	**100%**

Under a no action alternative trees continue to grow and canopies expand as noted in the 24 year time period (Table 32). In 2017, about 40.2% of the acres have a canopy cover of 40% or greater. By 2014 that number increases to 70.4%. Without large disturbance forested areas will trend towards high canopy cover. Continuous high canopy cover may alter fire behavior by having a larger potential for a sustained crown fire.

Table 32: No Action - Acres of Canopy Cover Class by Time Period.

	Pre Treat - 2017		Post Treat - 2021		2041	
Canopy Cover Class	Acres	% Forested Area	Acres	% Forested Area	Acres	% Forested Area
10-24.9%	2,368	19.5%	2,368	19.5%	592	4.9%
25-39.9%	4,888	40.3%	4,888	40.3%	3,000	24.7%
40-59.9%	4,364	36.0%	4,364	36.0%	4,975	41.0%
60% plus	517	4.2%	517	4.2%	3,570	29.4%
Sub Totals	**12,137**	**100%**	**12,137**	**100%**	**12,137**	**100%**

Forest Vegetation Structure – Vertical

In the No Action Alternative stands will continue to grow and trees will establish in the understory where there is available growing space, creating or adding to the layers. In certain stand condition's such as

dense, younger ponderosa pine, growing space is completely allocated and these tend to be single story. Vertical structure (or canopy layers) will be displayed in this section to show how vertical structure changes over the 24 year time period without a major disturbance event.

As discussed earlier new cohorts of trees can establish as stands continue to develop through time. Small breaks in canopy create open growing space for a new cohort of trees to grow and trees may begin to establish in the understory. These stand dynamics is what creates multiple canopy layers. Table 33 indicates that as the stands continue to develop over the next 24 years there will be minimal changes in the acres of canopy layers due to stand dynamics over time. Current conditions have 97.3% in continuous canopy layers. Stands continue to grow and shade out development of new tree establishment and understory mortality occurs. However, with small disturbances (i.e. insects, weather) in the overstory growing space is opened up and new seedlings develop to keep them in a state of a multi canopy cover condition. The existing single story stands are lower canopy stands with available growing space, new seedlings develop creating a 2 story condition. Amount of continuous canopy layers do not change by 2041, only change is existing single story moves into a condition of 2 canopy layers.

Continued layers of canopies (ladder fuels) may increase the risk for fires climbing into the crowns of trees and aid in sustaining an active crown fire.

Table 33: No Action - Acres by Canopy Layers Type by Time Period

	Pre Treat - 2017		Post Treat - 2021		2041	
Canopy Layers[1]	**Acres**	**% Forested Area**	**Acres**	**% Forested Area**	**Acres**	**% Forested Area**
1	332	2.7%	332	2.7%	23	0.2%
2	0	0.0%	0	0.0%	309	2.5%
3	0	0.0%	0	0.0%	0	0.0%
Continuous	11,805	97.3%	11,805	97.3%	11,805	97.3%
Sub Totals	**12,137**	**100.0%**	**12,137**	**100.0%**	**12,137**	**100.0%**

[1] Number denotes number of canopy layers. Continuous equals more than 3.

Forest Vegetation – Pine Beetle Hazard

Earlier the interaction of stand structure (basal area) and successional stage (diameter class) was discussed on how it relates to potential hazard to the individual insects of concern. Under the No Action (displayed above) basal areas continues to increase over the 24 year period assuming no large disturbance. Individual trees will increase in size further increasing competition. In general for all the insects of concern the larger the host trees are and as density (BA) of the forested area increase the higher the hazard rating becomes. Following is a discussion on how hazard ratings of pine beetle, change over the 24 year period under the no action scenario.

Pine beetle hazard for the majority of the existing condition is moderate due to the domination of the ponderosa pine cover type being in a diameter class and density (BA) that is of a quality (larger diameter) and quantity (host species and high BA's) for the beetle. By 2041, 99.8% of the acreage in the no action alternative has a rating of moderate and high with the highest amount in the high hazard (93.6%). This indicates that there is a sufficient quantity and quality of host available in the project area and if beetles are present and weather conditions are favorable a significant amount of mortality may occur across all of the project area.

Table 34: No Action - Percent of Forested Acres within the Project Area by Beetle Hazard.

	Pre Treat - 2017		2041		
Pine Beetle Hazard	**Acres**	**% Forested Area**	**Acres**	**% Forested Area**	**% Change 2009 - 2059**
Low	164	1.3%	29	0.2%	-1.1%
Moderate	10,910	89.9%	746	6.2%	-83.7%
High	1,063	8.8%	11,362	93.6%	+84.8%
Sub Totals	**12,137**	**100.0%**	**12,137**	**100.0%**	

Forest Vegetation - Planting

Reforesting the 253 acres of wildfire areas lacking a seed source will not occur. Restoration of the forest cover is expected to take several decades.

Summary of No Action to Forest Vegetation

Forest composition, structure (both horizontal and vertical) and the pattern of these on the landscape may determine how disturbance agents such as wildfire and insect outbreaks alter existing forest vegetation. Landscapes or stands that are dominated by forest conditions conducive to large disturbance events such as stand replacement wildfire and widespread insect outbreaks can result in socially undesirable results to the existing forest vegetation. Fire exclusion and limited disturbance events the last 100 years has resulted in a landscape of young age classes missing on the southern half of the landscape. There is a need to have spatial variability in stand density/structure/age classes as that may dampen subsequent bark beetle outbreaks because trees reach susceptible size at different times (Turner, Donato, Romme, 2012). Under the No Action Alternative the southern half of the project landscape is becoming more homogenous in stand conditions that place the majority of the landscape in a potential crown fire type and an insect hazard of potential high mortality if a mountain pine beetle epidemic were to occur. Having heterogeneous forest vegetation conditions (individual tree, clumps, openings and untreated areas) may allow disturbance agents to operate at a scale of disturbance that may be more acceptable socially and sustain portions of the exiting forest vegetation.

Assuming no large disturbances take place the existing ponderosa pine cover from 2017 to 2041 stays relatively constant with the exception of portions of the 3,414 acres of wildfire areas slowly naturally regenerating to additional ponderosa pine cover. Even though trees continue to grow the landscape stays dominated by the 10-14.9" size class. Currently for the existing forest cover there is no representation in the less than .1 inch classes (seedlings) from 2017 to 2041. Age classes will shift to older classes as individual trees age over the 24 year period. As noted above the identified microsites of old growth will continue to be subject to beetle mortality.

Approximately 40 percent of the existing forest vegetation in the project areas has been rated with a canopy cover 40% and greater and 60 percent with a canopy cover less than 40% (Table 35). By 2041, 70 percent would be $\geq$ 40%, a 30% increase (Table 32). These higher canopy cover percent's ($\geq$40%) on the landscape increase the risk that once fire has moved into the crowns the fire can continue burning in the upper canopy level. This condition increases the probability for stand replacement wildfire events. There is a need to reduce existing high canopy cover to reduce the effects of large disturbance events if they were to happen. This is especially important over time; left untreated 70% of the proposed treatment units will have $\geq$ 40% canopy cover.

Currently over 97 percent of the forested vegetation acreage in the Threemile project area have multiple canopy layers (3 or more) and remains the same in 2041 (Table 35). This structure presents a ladder effect for fire to climb into the crowns and initiate crown fire resulting in stand replacement events where continuous canopy cover exists (Graham, Mathews, 2010). About 3 percent of the project area has a single-story condition and changes to two-layer in 2041 (Table 33). This single story and two-story condition is more conducive to fire being maintained as a surface fire with a lower probability of a stand replacement wildfire events (conditional crown, active and passive). This is largely due to the fact when surface fires burn through areas with limited ladder fuels they are less likely to produce enough heat to ignite the over story fuels (Graham, Mathews, 2010). However, adjacent stands with continuous canopy layers and high canopy cover that support a crown fire may allow a crown fire to burn into these stand conditions. There is a need to move multi-layer conditions to a single or two layer condition and lessen the ladder effect of fire moving to the crowns by removal of all or some of the small diameter understory tree components, making them more resilient to wildfire. This could lower the probability of stand replacement wildfire events.

The No Action Alternative would not alter the Threemile project area landscape from existing to desired stand structures (see the Threemile Restoration and Resiliency Project Environmental Assessment and Scoping Document (Table 1 in the Environmetal Assessment and Table 1 in Scoping Document) Table 3). The cumulative effect from past, present, and reasonably foreseeable future actions has created a downward trend in resiliency to certain disturbances (i.e. high MPB mortality) and sustainability of the existing forest vegetation. Tree densities (BA) and canopy cover (horizontal cover) are expected to increase with continued fire suppression. This increases the risk for large stand replacement disturbances (wild fires, insects) reducing the ability to sustain the existing forested vegetation (see fuels section). Conversely, the proposed action alternatives decrease tree densities, canopy layers, and canopy cover at various levels and extent, which decrease the risk for large stand replacement events on treated acres, thus, increase the ability to sustain the forested vegetation.

Risk for bark beetle caused mortality is a function of stand density (BA) and diameter. The No Action Alternative does not effectively reduce stand density and over the next 24 years stand density (BA) is expected to increase (Table 35). Reductions in the small diameter understory trees are expected while larger trees remain increasing BA. Forest vegetation succession, growth and structure development would increase competition for water, light and nutrients resulting in lower stand vigor increasing the potential for insect outbreaks. Wildfire starts with effective suppression activities and endemic insect mortality would increase vegetation diversity on a small scale with individual trees and small area mortality. However, continued stand growth (diameter) and increased density (BA) on the project landscape are expected to maintain a dominance of moderate and high pine beetle hazard (Table 35). This is because the project landscape is dominated by a ponderosa pine cover type that is a specific host to the pine bark beetles (MPB). In 2017 and in 2041, over 98 percent of the project landscape exists in a condition for high quantity and quality of the host and if a MPB outbreak were to occur a high level of mortality would be expected, impacting the existing forest vegetation (Table 34).

Table 35: Resource Indicators and Measures for No Action

Resource Element	Resource Indicator	Acres	% Forested Area	Measure (% Change from Existing to Post Treatment 2021)	Measure (% Change from Post Treatment to 2041)
Forested Vegetation Composition - Size Class[1]	<1”	0	0.0%	0.0%	0.0%
	.1- 4.9"	21	0.2%	0.0%	0.0%
	5 - 9.9"	653	5.4%	0.0%	0.0%

Resource Element	Resource Indicator	Acres	% Forested Area	Measure (% Change from Existing to Post Treatment 2021)	Measure (% Change from Post Treatment to 2041)
	10- 14.9"	11,296	93.1%	0.0%	0.0%
	15” Plus	167	1.4%	0.0%	0.0%
Forest Vegetation Structure – Horizontal (Basal Area per acre)[1]	< 80	391	3.2%	0.0%	-1.8%
	≥ 80 and ≤ 120	3,441	28.3%	0.0%	-24.1%
	>120 and < 150	7,909	65.2%	0.0%	-39.2%
	≥150	396		0.0%	+65.1%
Forest Vegetation Structure – Horizontal (Canopy Cover)[1]	< 10%	0	0.0%	0.0%	0.0%
	10-24.9%	2,368	19.5%	0.0%	-14.6%
	25-39.9%	4,888	40.3%	0.0%	-15.6%
	40-59.9%	4,364	36%	0.0%	+5.0%
	60% plus	517	4.2%	0.0%	+25.2%
Forest Vegetation Structure –Vertical (Canopy Layers)[1]	1	332	2.7%	0.0%	-2.5%
	2	0	0%	0.0%	+2.5%
	3	0	0%	0.0%	0.0%
	Continuous	11,805	97.3%	0.0%	0.0%
Forest Vegetation – Pine Beetle Hazard[1]	Low	164	1.3%	+0.3%	-1.1%
	Moderate	10,910	89.9%	+0.1%	-83.7%
	High	1,063	8.8%	-0.4%	+84.8%
Forest Vegetation – Planting[2]	Acres Planted	0	0.0%	0.0%	0.0%

[1]Acres and % change does not include the 240 acres of currently non forested planting acres.
[2]Acres includes fire areas that are not currently forested (240 acres).

Alternative B – Modified Proposed Action

Alternative B proposes the same type of treatments as in Alternative A but on a different amount of acres (Table 36).

Table 36: Proposed Treatment Type Acres by Alternative.

Treatment Type	Alternative A	Alternative B	Difference
RXB PP	1,466	1,141	-325 (-22.2%)
RXB NF (Forested Acres)	599	398	-201 (-33.5%)
ICD	949	1,070	+121 (+11.3%)
REGEN ST	264	467	+203 (+43.5%)
CTM w/small openings	1,468	1,404	-64 (-4.3%)
PLT Existing Forest Cover	13	13	0 (0.0%)
Sub Total	4,759	4,493	-266 (-5.6%)
PLT Existing Non Forest Cover	240	240	0 (0.0%)
No Treatment	7,378	7,644	+266 (+3.5%)
Total	**12,377**	**12,377**	**0**

Forest Vegetation Composition (Size Class and Age)

Like Alternative A, a direct effect of the small regeneration treatments (REGEN ST and CTM small openings) is initiation of a new age class of ponderosa pine to create age class diversity. Alternative B accomplishes this on approximately 958 acres (Table 41). Indirectly the ICD treatments will initiate a new age class while still maintaining a large tree component. Existing average age classes in the larger trees classes will be maintained in the CTM thinning treatment areas (913 acres - Table 6). Similar to Alternative A, PLT treatments (240 acres) will create a new age class. No treatment areas will maintain the existing age classes. There will be trees regenerating in the understories of these intermediate (ICD and CTM thin areas) and no treatment areas that will be a younger age, however the over story trees age will be the dominant age class.

About 21% of the treated 4,493 acreage post treatment will initiate a new age class (Table 41)). Like in alternative A the PLT treatment of 240 acres will reestablish forest cover, while creating a new age class. Seventy nine percent of the treated acreage will generally maintain the age class representation, with the ICD, CTM and RXB treatments targeting the older age classes for retention (Table 6). In comparison The No Action Alternative maintains the existing condition and no new age class is created, except when small disturbances (insects, disease and storm mortality) occur. This action alternative also retains/protects large, old trees ($\geq$ 17" dbh and $\geq$ 180 years) (see design feature section above). Natural mortality (age, insects, diseases, storm damage) and applying prescribed fire could reduce this large, old tree component.

As described above in Alternative A, a new age class is a longer term strategy to increase resiliency to MPB outbreaks (see insect hazard section above). The REGEN ST, CTM small openings, and the PLT types of treatment specifically were targeted to create a new age class of ponderosa pine. A mix of small and medium sized openings through harvest will be created on 958 acres ranging in size from ½ to 10 acres for individual treatment units. Some of these individual openings that are adjacent will create openings up to 22 acres. No new age class will occur in the No Action Alternative.

As in Alternative A the RXB PP and RXB NF treatments are not intended to create new age classes, however canopy openings up to 1 acre in size on less than 1 percent of the treatment unit may occur where a new age class will be started (Table 14). Understories are likely to reinitiate post treatment, where overstory canopy mortality occurred resulting in available growing space. As with Alternative A small natural disturbances (insects, disease, wind, snow, etc.) will continue to occur across all the forested acreage that may initiate regeneration. Where WD treatments occur, they will have the same effect as described in Alternative A above.

Table 37: Alternative B - Acres of Size Class by Time Period by Treatment Type and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	Diameter Class (Inches)[1]	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
RXB PP	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	34	3.0%	+3.0%
	5 - 9.9"	43	3.8%	0	0.0%	-3.8%	0	0.0%	-3.8%
	10- 14.9"	1,071	93.8%	846	74.2%	-19.6%	895	78.4%	-15.4%
	15" Plus	27	2.4%	295	25.8%	+23.4%	212	18.6%	+16.2%
	Sub Totals	**1,141**	**100%**	**1,141**	**100%**		**1,141**	**100%**	
RXB	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	12	3.0%	+3.0%
	5 - 9.9"	22	5.6%	0	0.0%	-5.6%	0	0.0%	-5.6%

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	Diameter Class (Inches)[1]	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
	10- 14.9"	370	93.1%	300	75.4%	-17.7%	315	79.3%	-13.8%
	15" Plus	6	1.3%	98	24.6%	+23.3%	71	17.7%	+16.4%
	Sub Totals	**398**	**100%**	**398**	**100%**		**398**	**100%**	
ICD	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	5 - 9.9"	17	1.6%	6	0.6%	-1.0%	52	4.8%	+3.2%
	10- 14.9"	1,030	96.3%	298	27.8%	-68.5%	371	34.7%	-61.6%
	15" Plus	23	2.1%	766	71.6%	+69.5%	647	60.5%	+58.4%
	Sub Totals	**1,070**	**100%**	**1,070**	**100%**		**1,070**	**100%**	
REGEN	<.1"	0	0.0%	467	100%	+100%	0	0.0%	0.0%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	467	100%	+100%
	5 - 9.9"	1	0.2%	0	0.0%	-0.2%	0	0.0%	-0.2%
	10- 14.9"	445	95.3%	0	0.0%	-95.3%	0	0.0%	-95.3%
	15" Plus	21	4.5%	0	0.0%	-4.5%	0	0.0%	-4.5%
	Sub Totals	**467**	**100%**	**467**	**100%**		**467**	**100%**	
CTM	<.1"	0	0.0%	490	34.9%	+34.9%	0	0.0%	0.0%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	490	34.9%	+34.9%
	5 - 9.9"	6	0.4%	0	0.0%	-0.4%	0	0.0%	-0.4%
	10- 14.9"	1,338	95.3%	472	33.6%	-61.7%	353	25.2%	-70.1%
	15" Plus	60	4.3%	442	31.5%	+27.2%	561	39.9%	+35.6%
	Sub Totals	**1,404**	**100%**	**1,404**	**100%**		**1,404**	**100%**	
NO TREAT	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	21	0.3%	21	0.3%	0.0%	21	0.3%	0.0%
	5 - 9.9"	564	7.4%	564	7.4%	0.0%	564	7.4%	0.0%
	10- 14.9"	7,029	91.9%	7,029	91.9%	0.0%	7,029	91.9%	0.0%
	15" Plus	30	0.4%	30	0.4%	0.0%	30	0.4%	0.0%
	Sub Totals	**7,644**	**100%**	**7,644**	**100%**	**7,644**	**7,644**	**100%**	
PLT	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	5 - 9.9"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	10- 14.9"	13	100%	13	100%	0.0%	13	100%	0.0%
	15" Plus	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Sub Totals	**13**	**100%**	**13**	**100%**		**13**	**100%**	

[1]Diameter at 4.5 feet.

Forested Vegetation ICO Treatments (ICD, CTM, REGEN ST RXB PP, RXB NF, Post-Sale Non-commercial Thinning, and PLT):

ICD and CTM Thinning Treatments – Opening up the canopies in the ICD thinning treatments will allow for a new age class to establish on some of the treated acreage. This is not represented in the table due to the dry sites and the anticipated longer periods for establishment. The dominant size class tracked for this analysis and time period is the large trees.

Effects of these treatments are the same as described above in Alternative A. Pretreatment these treatments have 95.7% of the acreage in the 10-14.9" class and 3.3% in the 15"+ class (Table 37). Post treatment, they have 31.1% of the acreage in the 10-14.9" class and 48.8% in the 15" plus class. By 2041, these treatments promote 1,208 acres in the 15" + class. In comparison the No Action Alternative has only 1.4% (167 acres) in the 15" plus class (Table 28). Larger tree classes

are promoted in these treatments as compared to the No Action. This holds true for 2041, larger trees post treatment still are present but the smaller diameter trees (including new ingrowth, regeneration) have grown and are influencing the diameter classes. Alternative B still has higher percent of the acreage in the 15" + class (12.5%) when compared to the No Action of 1.4% (Table 44, Sandbak, 2018I).

RXB PP and RXB NF Treatments. – The effects of these post treatment are similar to those described in Alternative A above but on 526 acres less (Table 36). By 2041, 78.6% occurs in the 10-14.9" class and 18.4% in the 15"+ class. (Table 37, Sandbak, 2018 (I)). The No Action maintains a dominant 10-14.9" class through 2041 (Table 44). There is a small decrease in the 15"+ diameter class acres from post treatment to 2041 as a result of the understory response. Large trees classes are maintained for both Alternative B and the No Action, with a higher large tree representation post treatment and in 2041 for the Alternative B (Table 44, Sandbak, 2018I).

Post-Sale Non Commercial Thinning in ICD and CTM Thin Treatments – Same effects as those described in Alternative A above, but on 259 acres less.

No Treatment Areas – Same as those described in Alternative A but on 266 more acres.

PLT – Same effects as those described above in Alternative A.

WD Treatments (WD): Same effects as those described in Alternative A above.

Forest Vegetation Structure – Horizontal (Basal Area/Acre and Canopy Cover) and Vertical (Canopy Layers).

Horizontal - Basal Area

Effects of basal area are the similar to those described in Alternative A and existing conditions above.

Treatment Effects: Table 38 displays how basal area changes from treatment types and how they change as stands reestablish or increase in growth over the 24 year time period for Alternative B. Like in Alternative A above, regeneration harvests (REGEN ST), improvement cutting on dry sites (ICD), and small openings in the commercial thinning (CTM) remove the most trees thus the largest reductions in BA post treatments (Table 38). Commercial treatments ICD, CTM and REGEN ST thin trees post treatment to < 80 ft^2 and remain < 80 ft^2 in 2041 on 100% of the treatment acres. Retained clumps in the ICD and CTM treatments will have BA's that exceed 80 ft^2.

The same effects as described above for Alternative A occur in this Alternative but on 526 fewer acres in the RXB PP and RXB NF treatments. By 2041 the amount of acres less than 80 ft^2 return to existing levels and there is a 21.4% increase in acres in > 120 ft^2 (Table 38).

NO TREAT areas in Alternative B promote 91.5% of the forested acres with BA's $\geq$ 120 in the project area (57.6% of the project area - Table 38). Overall Alternative B promotes 40.7% $\geq$ 150 BA compare to the No Action Alternative at 68.4% (Table 46). Effects on the WD and the PLT acres are the same as described in Alternative A.

Table 38: Alternative B and No Action – Basal Area Ranges and Average Basal Area per Acre by Percent of Forested Area by Treatment Type by Time Period

Alternative/ Treatment Type		Pre Treat - 2017		Post Treat - 2021		2041	
	Average Basal Area Per Acre Range (BA/ft^2)	Acres	% of Forested Area	Acres	% of Forested Area	Acres	% of Forested Area
B - RXB PP	< 80	42	3.7%	92	8.1%	42	3.7%
	≥ 80 and ≤ 120	337	29.5%	789	69.1%	81	7.1%
	>120 but < 150	697	61.1%	260	22.8%	758	66.4%
	≥150	65	5.7%	0	0.0%	260	22.8%
	Total	**1,141**	**100%**	**1,141**	**100%**	**1,141**	**100%**
B - RXB NF	< 80	23	5.8%	24	6.0%	23	5.8%
	≥ 80 and ≤ 120	78	19.6%	351	88.2%	4	1.0%
	>120 but < 150	296	74.4%	23	5.8%	348	87.4%
	≥150	1	0.2%	0	0.0%	23	5.8%
	Total	**398**	**100%**	**398**	**100%**	**398**	**100%**
B - ICD	< 80	0	0.0%	1,070	100%	1,070	100%
	≥ 80 and ≤ 120	335	31.3%	0	0.0%	0	0.0%
	>120 but < 150	697	65.1%	0	0.0%	0	0.0%
	≥150	38	3.6%	0	0.0%	0	0.0%
	Total	**1,070**	**100%**	**1,070**	**100%**	**1,070**	**100%**
B – REGEN ST	< 80	0	0.0%	467	100%	467	100%
	≥ 80 and ≤ 120	0	0.0%	0	0.0%	0	0.0%
	>120 but < 150	423	90.6%	0	0.0%	0	0.0%
	≥150	44	9.4%	0	0.0%	0	0.0%
	Total	**467**	**100%**	**467**	**100%**	**467**	**100%**
B - CTM	< 80	0	0.0%	1,404	100%	1,404	100%
	≥ 80 and ≤ 120	11	0.8%	0	0.0%	0	0.0%
	>120 but < 150	1,214	86.5%	0	0.0%	0	0.0%
	≥150	179	12.7%	0	0.0%	0	0.0%
	Total	**1,404**	**100%**	**1.404**	**100%**	**1.404**	**100%**
B – NO TREAT	< 80	402	5.3%	402	5.3%	154	2.0%
	≥ 80 and ≤ 120	2,594	33.9%	2,594	33.9%	493	6.5%
	>120 but < 150	4,524	59.2%	4,524	59%	2,349	30.7%
	≥150	124	1.6%	124	1.6%	4,648	60.8%
	Total	**7,644**	**100%**	**7,644**	**100%**	**7,644**	**100%**
B - PLT	< 80	0	0.0%	0	0.0%	0	0.0%
	≥ 80 and ≤ 120	0	0.0%	0	0.0%	0	0.0%
	>120 but < 150	13	100%	13	100%	0	0.0%
	≥150	0	0.0%	0	0.0%	13	100%
	Total	**13**	**100%**	**13**	**100%**	**13**	**100%**
No Action	< 80	391	3.2%	391	3.2%	164	1.4%
	≥ 80 and ≤ 120	3,441	28.3%	3,441	28.3%	508	4.2%
	>120 but < 150	7,909	65.2%	7,909	65.2%	3,160	26%
	≥150	396	3.3%	396	3.3%	8,305	68.4%
	Total	**12,137**	**100%**	**12,137**	**100%**	**12,137**	**100%**

Horizontal - Canopy Cover

Canopy cover effects are the same as described above in Alternative A. Like in Alternative A, ICD, CTM, and REGEN ST treatments have the greatest impact on changing canopy cover from existing (Table 39, Sandbak, 2018I).

Forested Vegetation ICO Treatments (ICD, CTM, REGEN ST RXB PP, RXB NF, Post-Sale Non-commercial Thinning, and PLT):

ICD and CTM Treatments (Individual Trees/Clumps)–
Treatment effects are the same as described above in Alternative A but on 57 acres less (Table 36). The CTM treatment areas in post-treatment has the majority (49.9%) of the canopy cover in the 25-39% class (Table 39). With the small openings the CTM will have 35.0% in less than 10% canopy cover. By 2041 the majority of the acreage in the CTM will be < 40% (53.6%). The ICD treatments will promote 42.9% with < 40% canopy cover. Like in Alternative A large trees will be promoted and the clumping of trees will add diversity to higher canopy cover within the treatment units.

REGEN ST and CTM Small Opening Treatments (Openings) - Treatment effects are the same as described above in Alternative A acres but on about 23 acres less in the CTM small openings and 203 more acres in the REGEN ST (Table 36). Pretreatment these areas are dominated by > 40% canopy cover (Table 39). By 2041, 54.3% of the area has a canopy cover in ≥40% class and the remainder <40% (Sandbak 2018J and Table 39).

RXB PP and RXB NF Treatments (Clumps) – Treatment effects are similar to those described above in Alternative A but on 526 acres less (Tables 36). Pretreatment these areas are dominated by <40% canopy (65.4%). Prescribe fire treatments promote 71% of the area in this canopy class. With continued stand development 61.2% has canopy cover ≥ 40% by 2041. In comparison, the No Action Alternative will have 70.4% of the acreage with 40% plus canopy (Sandbak, 2018I and Table 46).

Post-Sale Non Commercial Thinning in ICD and CTM Thin Treatments (Individual Tree/Clumps) – Same effects as in Alternative A above.

No Treatment Areas (Skips/Clumps) – Similar effects to those described above in Alternative A but 266 more acres in this alternative will not be treated (Table 36). Pretreatment these areas are dominated by canopy covers <40% (67%). By 2041, with continued stand growth 69.9% will have a canopy cover >40% (Table 39).

PLT – Same effects as those described in Alternative A above.

WD Treatments (WD): Same effects as those described in Alternative A above.

By comparison in the No Action Alternative across all the treatment areas discussed above the existing condition of domination of canopy cover < 40% pretreatment continues to develop. By 2041 seventy percent of the acreage is 40% and greater with 29.4% in the 60% plus class (Table 46).

Table 39: Alternative B - Acres of Canopy Cover Class by Treatment Type by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	Canopy Cover	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
RXB PP	<10%	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	10-24.9%	256	22.4%	327	28.7%	+6.3%	82	7.2%	-15.2%
	25-39.9%	519	45.5%	508	44.5%	-1.0%	372	32.6%	-12.9%
	40-59.9%	316	27.7%	266	23.3%	-4.4%	487	42.7%	+15.0%
	60% plus	50	4.4%	40	3.5%	-0.9%	200	17.5%	+13.1%
	Sub Totals	**1,141**	**100%**	**1,141**	**100%**		**1,140**	**100%**	
RXB NF	<10%	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	10-24.9%	81	20.3%	104	26.2%	+5.9%	26	6.5%	-13.8%
	25-39.9%	151	38.0%	154	38.8%	+0.8%	117	29.4%	-8.6%
	40-59.9%	141	35.3%	119	29.9%	-5.4%	163	41.0%	+5.7%
	60% plus	25	6.4%	21	5.1%	-1.3%	92	23.1%	+16.7%
	Sub Totals	**398**	**100%**	**398**	**100%**		**398**	**100%**	
ICD	<10%	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	10-24.9%	94	8.8%	1,018	95.1%	+86.3%	51	4.8%	-4.0%
	25-39.9%	387	36.2%	1	0.1%	-36.1%	408	38.1%	+1.9%
	40-59.9%	543	50.7%	40	3.8%	-46.9%	549	51.3%	+0.6%
	60% plus	46	4.3%	11	1.0%	-3.3%	62	5.8%	+1.5%
	Sub Totals	**1,070**	**100%**	**1,070**	**100%**		**1,070**	**100%**	
REGEN ST	<10%	0	0.0%	467	100%	+100%	0	0.0%	0.0%
	10-24.9%	11	2.3%	0	-2.3%	-2.3%	9	2.0%	-0.3%
	25-39.9%	138	29.6%	0	0.0%	-29.6%	94	20.0%	-9.6
	40-59.9%	282	60.5%	0	0.0%	-60.5%	280	60.0%	-0.5%
	60% plus	36	7.6%	0	0.0%	-7.6%	84	18.0%	+10.4%
	Sub Totals	**467**	**100%**	**467**	**100%**		**467**	**100%**	
CTM	<10%	0	0.0%	491	35.0%	+35.0%	0	0.0%	0.0%
	10-24.9%	53	3.8%	121	8.6%	+4.8%	24	1.7%	-2.1%
	25-39.9%	430	30.6%	700	49.9%	+19.3%	728	51.9%	+21.3%
	40-59.9%	787	56.0%	79	5.6%	-50.4%	495	35.2%	-20.8%
	60% plus	134	9.6%	13	0.9%	-8.7%	157	11.2%	+1.6%
	Sub Totals	**1,404**	**100%**	**1,404**	**100%**		**1,404**	**100%**	
NO TREAT	<10%	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	10-24.9%	1,866	24.4%	1,866	24.4%	0.0%	467	6.1%	18.3%
	25-39.9%	3,257	42.6%	3,257	42.6%	0.0%	2,214	29.0%	-13.6%
	40-59.9%	2,295	30.0%	2,295	30.0%	0.0%	3,131	40.9%	+10.9%
	60% plus	226	3.0%	226	3.0%	0.0%	1,832	24.0%	+21.0%
	Sub Totals	**7,644**	**100%**	**7,644**	**100%**		**7,644**	**100%**	
PLT	<10%	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	10-24.9%	5	40.7%	5	40.7%	0.0%	1	8.1%	-32.6%
	25-39.9%	5	39.2%	5	39.2%	0.0%	7	52.2%	+13.0%
	40-59.9%	3	20.1%	3	20.1%	0.0%	4	35.7%	+15.6%
	60% plus	0	0.0%	0	0.0%	0.0%	1	4.0%	+4.0%
	Sub Totals	**13**	**100%**	**13**	**100%**		**13**	**100%**	

Vertical – Canopy Layers

Effects of canopy layers are similar to Alternative A as described above. Alternative B has 266 acres less treatments and a different amount acreage within most of the treatments (Table 36). Like Alternative A

commercial treatment areas have the largest impact on the canopy layers in 2021 (post treatment) with the designed thinning from below treatments that remove the ladder fuels and regeneration treatments designed to create a single story new age class.

Forested Vegetation ICO Treatments (ICD, CTM, REGEN ST RXB PP, RXB NF, Post-Sale Non-commercial Thinning, and PLT):

ICD and CTM Treatments (Individual Trees/Clumps) – Alternative B treats 121 acres more with ICD and 64 acres less with CTM than Alternative A. Pretreatment these areas are dominated by a continuous canopy layer (98.5% and 100%). Post treatment the ICD is dominated by a single canopy layer (80.1%) and the CTM by a single layer (85.0%) with 15.0% in a 2 layer condition (Table 40). By 2041 the ICD is dominated by a 2 layer condition (90.1%), and 9.9% in single. The CTM is dominated by a 2 canopy layer condition (85%), with 15% in a 3 story condition. Small areas where clumps are maintained could develop into continuous canopy conditions (up to 8% of the area).

REGEN ST and CTM Small Opening Treatments (Openings) – Alternative B treats 203 more acres with a REGEN ST treatment and will have about 23 acres less in small openings with the CTM treatment than Alternative A. These areas are like the rest of the existing condition and are dominated by continuous canopy layers (100%). With removal of all but the seed trees the canopy is reduced to a single layer condition. By 2041 the regeneration post treatment and beyond creates a 2 layered canopy condition (Table 40 and Sandbak, 2018I).

RXB PP and RXB NF Treatments (Clumps) – Alternative B treats 526 fewer acres with RXB than Alternative A. Pretreatment these areas are dominated by continuous canopy layers (95.9% and 94.7%). Post treatment RXB PP reduces the continuous canopy layers by 67.1% and the RXB NF by 66.3% (Table 40). Post treatment together these treatments promote 61.5% of the acres in 2 story and single story post treatment. These treatments by 2041 a 2 layer canopy structure dominates (45.1%) with 53.8% in 3 or more canopy layers. By comparison the No Action Alternative is dominated by continuous canopy layers in 2021 and in 2041at 97.3% (Table 47 and Sandbak, 2018 I). Large trees are promoted, and these RXB treatments create growing space where new age classes are developed increasing canopy layers by 2041.

Post-Sale Non Commercial Thinning in ICD and CTM Thin Treatments (Individual Tree/Clumps) – The same effects as described in Alternative A above but on about 162 more acres.

No Treatment Areas (Skips/Clumps) – Similar effects as those described in Alternative A above except 266 more acres in Alternative B will not be treated. Pretreatment a domination of continuous canopy conditions of 96.0% which remains throughout the 24 year time period (Table 40). Reduction of 3.7% in single story acres by 2041 that develop into 2 story (Table 40).

PLT – Same effects and acres treated as proposed in Alternative A above.

WD Treatments (Individual Tree) - Same effects as those described in Alternative A above.

Cumulatively post treatment (2021) Alternative B has 27.6% with a single canopy layer, 7.0% with 2, and 65.4% with 3 or more canopy layers (Sandbak, 2018I and Table 47). By 2041, about one percent has a single layer, 29.7% 2 layers, and 69.1% has 3 or more layers. In comparison

the No Action in 2021 has 97.3% with continuous layers and 2.7% with a single layer. By 2041, this changes to 0.2% with a single layer, 2.5% with 2 layers and 97.3% with continuous layers (Sandbak, 2018I and Table 40). Alternative B promotes 30.9% of the area in 2 or less canopies, while the No Action Alternative promotes 2.7% (Table 33 and Table 44).

Table 40: Alternative B - Acres of Canopy Layer Class by Treatment Type by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	Canopy Layers[1]	Acres	% Forested Area	Acres	% Forested Area	% Change 2009 - 2019	Acres	% Forested Area	% Change 2009 - 2059
RXB PP	1	47	4.1%	373	32.7%	+28.6%	13	1.1%	-3.0%
	2	0	0.0%	323	28.3%	+28.3%	506	44.4%	+44.4%
	3	0	0.0%	117	10.2%	+10.2%	260	22.8%	+22.8%
	Continuous	1,094	95.9%	328	28.8%	-67.1%	362	31.7%	-64.2%
	Sub Totals	**1,141**	**100%**	**1,141**	**100%**		**1,141**	**100%**	
RXB NF	1	21	5.3%	148	37.1%	+31.8%	4	1.0%	-4.3%
	2	0	0.0%	103	26.0%	+26.0%	188	47.4%	+47.4%
	3	0	0.0%	34	8.5%	+8.5%	82	20.6%	+20.6%
	Continuous	377	94.7%	113	28.4%	-66.3%	124	31.0%	-63.7%
	Sub Totals	**398**	**100%**	**398**	**100%**		**398**	**100%**	
ICD	1	17	1.5%	857	80.1%	+78.6%	106	9.9%	8.4%
	2	0	0.0%	213	19.9%	+19.9%	964	90.1%	+90.1%
	3	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Continuous	1,053	98.5%	0	0.0%	-98.5%	0	0.0%	-98.5%
	Sub Totals	**1,070**	**100%**	**1,070**	**100%**		**1,070**	**100%**	
REGEN ST	1	0	0.0%	467	100%	+100%	0	0.0%	0.0%
	2	0	0.0%	0	0.0%	0.0%	467	100%	+100%
	3	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Continuous	467	100%	0	0.0%	-100%	0	0.%	-100%
	Sub Totals	**467**	**100%**	**467**	**100%**		**467**	**100%**	
CTM	1	0	0.0%	1,194	85.0%	+85.0%	0	0.0%	0.0%
	2	0	0.0%	210	15.0%	+15.0%	1,194	85.0%	+85.0%
	3	0	0.0%	0	0.0%	0.0%	210	15.0%	+15.0%
	Continuous	1,404	100%	0	0.0%	-100%	0	0.0%	-100%
	Sub Totals	**1,404**	**100%**	**1,404**	**100%**		**1,404**	**100%**	
NO TREAT	1	306	4.0%	306	4.0%	0.0%	20	0.3%	-3.7%
	2	0	0.0%	0	0.0%	0.0%	286	3.7%	+3.7%
	3	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Continuous	7,338	96.0%	7,338	96.0%	0.0%	7,338	96.0%	0.0%
	Sub Totals	**7,644**	**100%**	**7,644**	**100%**		**7,644**	**100%**	
PLT	1	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	2	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	3	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Continuous	13	100%	13	100%	0.0%	13	100%	0.0%
	Sub Totals	**13**	**100%**	**13**	**100%**		**13**	**100%**	

[1] Number denotes number of canopy layers. Continuous equals more than 3.

Forest Vegetation – Pine Beetle Hazard

Approximately 99% of existing forest vegetation in Alternative B acreage is in moderate to high hazard for MPB (Table 48). Due to stand conditions (quantity and quality of available hosts); large amounts of mortality could be expected if an outbreak were to occur.

Like described above in Alternative A creation of age class and density mosaics results in landscapes that are not entirely susceptible at the same time period. Alternative B creates a new age class on about 4.0% of the existing forested project area in multiple small openings ranging in size from ½ to 4 acres size (CTM). Sixty six openings will be created ranging in size from 0.2 to 22.1 acres in size on 3.9% of the forested acres (REGEN ST). No openings will be created that exceed 40 acres. Five different density mosaics will be promoted using clumps and individual tree thinning prescriptions and prescribed fire on about 37% of the forested project area (Table 41). No treatment (skips) will generally promote the existing condition (TPA >25 and medium and large clumps) on about 63% of the project area. Planting in fire areas will return forest cover and create an additional 240 acres of a new age class. Table 41 displays these treatment variations by percent of existing forested acres and by percent of proposed treatment acres in Alternative B. Implementation of Alternative B will promote various densities of large ponderosa pine on about 91% of the existing forested area. All of these variations of treatments have effects on the hazard ratings for MPB and will be discussed below.

Table 41: Alternative B ICO's - Acres of Treatment Types by Percent of Forested Area and Treatment Acres.

		Individual Trees			Clumps		Skips	Openings (New Age Class)		
		ICD	REGEN ST, CTM (Small Openings)	CTM (Thin) Areas	Medium to Large Clumps RXB PP, RXB NF, NT's	Small Clumps, ICD, CTM Thin, PLT Areas	No Treatment	REGEN ST, CTM Small Openings	Promote Large Pine Trees	Promote Return Forest Cover
Alternative/ Treatment	**RX Acres**	**TPA 1 -10**	**TPA 6 - 10**	**TPA 15-25**	**Clumps > 4+ TPA**	**Clumps 2 – 4 TPA**	**TPA >25**			
RXB PP	1,141				1,141				1,141	
RXB NF	398				398				398	
ICD	1,070	984				86			1,070	
REGEN ST	467		467					467		
CTM	1,404		491	840		73		491	840	
No Treatment (NT)	7,644				7,644		7,644		7,644	
PLT	13					13				240
Totals	**12,137**	**984**	**958**	**840**	**9,183**	**172**	**7,644**	**958**	**11,093**	**240**
Percent of Forested Area		**8.1%**	**7.9%**	**6.9%**	**12.7%[1] 75.7%[2]**	**1.4%**	**63.0%**	**7.9%**	**91.4%[2]**	
Percent of Treatment Acres		**21.9%**	**21.3%**	**18.7%**	**34.3%[1]**	**3.8%**	**0%**	**21.3%**	**76.7%[1]**	

[1]Percent do not include No Treatment acres. [2]Percent includes No Treatment Acres.

Effects to the forest vegetation for beetle hazard are similar to those discussed above in Alternative A. The difference is a different set of treatment acres (Table 36).

Table 42: Alternative B - Acres of Beetle Hazard by Treatment Type by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Treatment	Pine Beetle Hazard	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
RXB PP	Low	9	0.8%	9	0.8%	0.0%	9	0.8%	0.0%
	Moderate	1,064	93.3%	1,131	99.2%	+5.9%	100	8.7%	-84.6%
	High	67	5.9%	0	0.0%	-5.9%	1,031	90.4%	+84.5%
	Sub Totals	**1,140**	**100%**	**1,140**	**100%**		**1,140**	**100%**	
RXB NF	Low	3	0.6%	3	0.6%	0.0%	3	0.6%	0.0%
	Moderate	391	98.4%	395	99.4%	+1.0%	25	6.3%	-92.1%
	High	4	1.0%	0	0.0%	-1.0%	370	93.1%	+92.1%
	Sub Totals	**398**	**100%**	**398**	**100%**		**398**	**100%**	
ICD	Low	0	0.0%	1,016	95.0%	+95.0%	1,016	95.0%	+95.0%
	Moderate	1,031	96.4%	0	0.0%	-96.4%	0	0.0%	-96.4%
	High	39	3.6%	54	5.0%	+1.4%	54	5.0%	+1.4%
	Sub Totals	**1,070**	**100%**	**1,070**	**100%**		**1,070**	**100%**	
REGEN ST	Low	0	0.0%	467	100%	+100%	467	100%	+100%
	Moderate	451	96.5%	0	0.0%	-96.5%	0	0.0%	-96.5%
	High	16	3.5%	0	0.0%	-3.5%	0	0.0%	-3.5%
	Sub Totals	**467**	**100%**	**467**	**100%**		**467**	**100%**	
CTM	Low	0	0.0%	1,292	92%	+92%	491	35.0%	+35.0%
	Moderate	1,404	100%	0	0.0%	-100%	801	57.0%	-43.0%
	High	0	0.0%	112	8.0%	+8.0%	112	8.0%	+8.0%
	Sub Totals	**1,404**	**100%**	**1,404**	**100%**		**1,404**	**100%**	
NO TREAT	Low	154	2.0%	162	2.1%	+0.1%	8	0.1%	-1.9%
	Moderate	6,606	86.4%	6,598	86.3%	-0.1%	690	9.0%	-77.4%
	High	884	11.6%	884	11.6%	0.0%	6,946	90.9%	+79.3%
	Sub Totals	**7,644**	**100%**	**7,644**	**100%**		**7,644**	**100%**	
PLT	Low	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Moderate	13	100%	13	100%	0.0%	13	100%	0.0%
	High	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Sub Totals	**13**	**100%**	**13**	**100%**		**13**	**100%**	

Forested Vegetation ICO Treatments (ICD, CTM, REGEN ST RXB PP, RXB NF, Post-Sale Non-commercial Thinning, and PLT): Like in Alternative A individually these treatments have different effects on beetle hazard post treatment (Table 42). Effects are similar to those described above in Alternative A but on a different amount of acres (Table 36).

ICD and CTM Treatments (Individual Trees/Clumps) – Effects are similar to those described above in Alternative A, but on 121 more acres. Post treatment on the ICD areas 95% of the high hazard is reduced to low hazard (Table 42). Five percent of the area where clumps will be retained will have a high hazard. These hazard levels remain in 2041. The CTM treatments

reduce initially beetle hazard to low by moving 92% of the moderate hazard to low hazard. Eight percent remain in high due to retained clumps.

REGEN ST and CTM Small Opening Treatments (Openings) – Effects are similar as those described above in Alternative A, but on 203 more acres in the REGEN ST and about 23 acres less in small openings. Although seed trees still remain at risk post treatment 100% is reduced to a low hazard (Table 42). By 2041, both of these treatments remain in a low hazard. Like in Alternative A these are the only ICO treatments that retains 100% of the treatment acres in low hazard from post treatment through 2041.

RXB PP and RXB NF Treatments (Clumps) – Effects are similar to those described in Alternative A above but on 526 acres less. The only shift is the 4.6% of high hazard is reduced to moderate. By 2041, beetle hazard is high on 97.3% of the acres. In comparison the No Action in 2041, 93.6% is high hazard (Table 34).

Post-Sale Non Commercial Thinning in ICD and CTM Thin Treatments (Individual Tree/Clumps) – Same effects as described in Alternative A above but on 67 fewer acres.

No Treatment Areas (Skips/Clumps) – Same effects as described in Alternative A above. Alternative B has 266 more acres of no treatment. Pretreatment these areas are dominated by moderate hazard (86.4%) and by 2041 they are dominated by high hazard (90.9%).

PLT – See Alternative A for effects, same amount of acres are treated.

WD Treatments (Individual Tree) – Effects are the same as those described in Alternative A above.

Cumulatively for these ICO post treatments (2021) Alternative B has 8.6% with a high hazard, 67.1% moderate, and 24.3% low hazard (Table 48). The newly forested 240 acres will have no hazard through the time period. By 2041, about seventy percent has a high hazard, 13.4% a moderate hazard, and 16.5 % low hazard. In comparison the No Action has 8.5% high hazard, 89.9% moderate hazard and 1.6% low hazard. In 2041 high hazard changed to 93.7%, moderate to 6.1% and low to 0.2%. Alternative B promotes about 14% more acres in low hazard than the No Action Alternative in 2041 than that in pretreatment condition on the existing forested acres. (Table 48).

Forest Vegetation - Planting

Alternative B effects from planting are those described in the existing condition and in Alternative A above. Same acreage is proposed for planting in Alternative A.

Summary of Direct and Indirect Effects

Following is a summary of the direct and indirect effects on the acres treated for the resource indicators as displayed in Table 43:

Pretreatment (2017) to Post Treatment (2021):

- Cover Type – maintain existing ponderosa pine cover on the 4,493 treated acres with a gain of 240 acres of forest cover in burned areas.
- Size Class – 21.3% gain in initiation of tree class size < .1" and gain of 32.6% in 15" plus size class; corresponding loss in the 5-9.9" and 10 -14.9" classes.
- Basal Area per Acre – 66.6% gain in acres having < 80 ft^2.
- Canopy Cover Class – 39.4% reduction in 40% and greater canopy cover and corresponding gain in less than 40%.
- Canopy Layer Class – 84.6% loss in 3 or more canopy layers with gain in 2 or less.
- Beetle Hazard – 61.8% gain in low hazard.
- Planting – 243 acres of planting.

Pretreatment (2017) to 2041:

- Cover Type – maintain existing ponderosa pine cover in the project area with a gain of 240 acres of forest cover in burned areas.
- Size Class – 22.3% gain in tree class size .1 – 4.9" inch and gain of 30.2% in 15" plus size class; corresponding loss in the 5-9.9" and 10 -14.9" classes. Gains in small size class due to CTM (small openings) and REGEN ST treatments. Gains in large size class due to intermediate treatments (ICD and CTM) of thinning from below and promoting large trees.
- Basal Area per Acre – 65.5% gain in acres having < 80 ft^2.
- Canopy Cover Class – 4.7% gain in 40% and greater canopy cover and corresponding loss in less than 40%. Gains are due to continued stand development in the intermediate treatments.
- Canopy Layer Class – 79.4% loss in 3 or more canopy layers with gain in 2 or less.
- Beetle Hazard – 43.9% gain in low hazard.
- Planting – 243 acres of planting.

Table 43: Resource indicators and measures for Alternative B – Direct Indirect Effects[1]

Resource Element	Resource Indicator	Existing Acres	% Forested Treatment Acres	Measure (% Change from Existing to Post Treatment 2021)	Measure (% Change from Post Treatment to 2041)
Forested Vegetation Composition - Size Class[1]	<1"	0	0.0%	+21.3%	0.0%
	.1- 4.9"	0	0.0%	0.0%	+22.3%
	5 - 9.9"	89	2.0%	-1.9%	-0.8%
	10- 14.9"	4,267	95.0%	-52.0%	-51.7%
	15" Plus	137	3.0%	+32.6%	+30.2%
		4,493	100%	0.0%	0.0%
Forest Vegetation Structure – Horizontal (Basal Area per acre)[1]	< 80	65	1.4%	+66.6%	+65.5%
	≥ 80 and ≤ 120	761	16.9%	+8.5%	-15.0%
	>120 and < 150	3,340	74.4%	-67.8%	-49.8%
	≥150	327	7.3%	-7.3%	-0.7%
		4,493	100%	0.0%	0.0%
Forest Vegetation Structure – Horizontal (Canopy Cover)[1]	<10%	0	0.0%	+21.4%	0.0%
	10-24.9%	500	11.1%	+23.9%	-6.8%
	25-39.9%	1,630	36.3%	-5.9%	+2.1%
	40-59.9%	2,072	46.1%	-34.8%	-2.1%
	60% plus	291	6.5%	-4.6%	+6.8%
		4,493	100%	0.0%	0.0%
Forest Vegetation Structure –Vertical (Canopy Layers)[1]	1	85	1.9%	+65.7%	+54.5%
	2	0	0.0%	+18.9%	+24.9%
	3	0	0.0%	+3.4%	+7.6%

Resource Element	Resource Indicator	Existing Acres	% Forested Treatment Acres	Measure (% Change from Existing to Post Treatment 2021)	Measure (% Change from Post Treatment to 2041)
	Continuous	4,408	98.1%	-88.0%	-87.0%
			100%	0.0%	0.0%
Forest Vegetation – Pine Beetle Hazard[1]	Low	13	0.3%	+61.8%	+43.9%
	Moderate	4,354	96.9%	-62.7%	-76.0%
	High	126	2.8%	+0.9%	+32.1%
		4,493	100%	0.0%	0.0%
Forest Vegetation – Planting[2]	Acres Planted	253	0.0%	+100%	+100%

[1]Acres and % change does not include the 240 acres of currently non forested planting acres.

[2]Acres includes fire areas that are not currently forested (240 acres).

Cumulative Effects

Spatial and Temporal Context for Effects Analysis

Same as Alternative A above.

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

The effects of past activities are the same as those described above in the Alternative A.
Present and reasonably foreseeable activities are the same as those described under the No Action Alternative.

Forest Vegetation Composition (Size Class and Age)

Effects of thinning are the same as described above in Alternative A. Alternative B has a net increase (+11.1%) in the largest diameter size class compared to 0% in the No Action Alternative. Alternative B promotes large trees on the landscape. In 2021 (post treatment), 13.4% of the forested acres will be size classes 15"+, in comparison to the No Action Alternative of 1.4% (Table 44). Alternative B post treatment promotes more acreage in the large tree class (1,632 vs. 167) than the No Action Alternative.

Alternative B has all 5 size classes represented (<.1", .1 – 4.9, 5-9.9", 10'-14.9", 15"+) in 2021. With 7.9% in the <.1" class, .2% in the .1-4.9" class, 4.7% in the 5-9.9" class, 73.8% in the 10-14.9" class, and 13.4% in the 15" + class. The small size classes represented in Alternative B is due to the REGEN ST and CTM small opening treatments that initiated a new age class. In comparison the No Action Alternative has 4 size classes represented (.1 – 4.9, 5-9.9", 10'-14.9", 15"+) with 93.1% in the 10-14.9" class (Table 44).

Post treatment (2021), Alternative B promotes more acreage in the large tree class than the No Action Alternative and has more size classes represented. By 2041, both Alternative B and the No Action have 4 size classes. The No Action has about 8.2% less acreage in the 5-9.9" size class than Alternative B. The No Action Alternative has less diversity in the size class representation than the Action Alternative with 93.1% in the one size class (10 – 14.9").

Alternative B initiates 958 acres of a new age class (7.9% of forested acres in the project area) through implementation of the treatments on existing forested acres. An additional 240 acres will be planted to increase forested acres. The No Action Alternative will not add a new age class on existing forested acres. Both alternatives will increase forest cover and add a new age class as the wildfire areas slowly reestablish in the northern part of the project area.

Table 44: Alternative B - Acres of Size Class by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Alternative	Diameter Class (Inches)[1]	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
B	<.1"	0	0.0%	956	7.9%	+7.9%	0	0%	0%
	.1- 4.9"	21	0.2%	21	0.2%	0.0%	1,023	8.4%	+8.2%
	5 - 9.9"	653	5.4%	570	4.7%	-0.7%	617	5.1%	-0.3%
	10- 14.9"	11,296	93.0%	8,958	73.8%	-19.3%	8,977	74.0%	-19.0%
	15" Plus	167	1.4%	1,632	13.4%	+12.0%	1,520	12.5%	+11.1%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	
No Action	<.1"	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	.1- 4.9"	21	0.2%	21	0.2%	0.0%	21	0.2%	0.0%
	5 - 9.9"	653	5.4%	653	5.4%	0.0%	653	5.4%	0.0%
	10- 14.9"	11,296	93.1%	11,296	93.1%	0.0%	11,296	93.1%	0.0%
	15" Plus	167	1.4%	167	1.4%	0.0%	167	1.4%	0.0%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	

[1]Diameter at 4.5 feet.

Forest Vegetation Structure – Horizontal (Basal Area/Acre and Canopy Cover) and Vertical (Canopy Layers).

Horizontal - Basal Area

Effects of basal area are the same as described in Alternative A and existing conditions above. Acres of average basal area ranges for Alternative B and the No Action Alternative by time period are displayed in Table 45. Pretreatment acres for Alternative B has 96.2% of the acres $\geq$ 80 ft^2. Post treatment Alternative B has 28.5% of the acres < 80ft^2, the No Action has 3.2%. By the end of the 24 year period there are 8,977 acres (74.0%) $\geq$ 80ft^2 in Alternative B. By comparison the No Action alternative has 96.8% of the acres in 2021 and in 2041 has 98.6% (11,973 acres) $\geq$ 80ft^2.

Table 45: Alternative B and No Action – Basal Area Ranges and Average Basal Area per Acre by Percent of Forested Area by Time Period

		Pre Treat - 2017		Post Treat - 2021		2041	
Alternative	Average Basal Area Per Acre Range (BA/ft^2)	Acres	% of Forested Area	Acres	% of Forested Area	Acres	% of Forested Area
B	< 80	467	3.8%	3,459	28.5%	3,160	26.0%
	$\geq$ 80 and $\leq$ 120	3,355	27.7%	3,734	30.8%	579	4.8%
	>120 but < 150	7,865	64.8%	4,820	39.7%	3,454	28.5%

Alternative		Pre Treat - 2017		Post Treat - 2021		2041	
	Average Basal Area Per Acre Range (BA/ft^2)	Acres	% of Forested Area	Acres	% of Forested Area	Acres	% of Forested Area
	≥150	450	3.7%	124	1.0%	4,944	40.7%
	Total	**12,137**	**100%**	**12,137**	**100%**	**12,137**	**100%**
No	< 80	391	3.2%	391	3.2%	164	1.4%
	≥ 80 and ≤ 120	3,441	28.3%	3,441	28.3%	508	4.2%
	>120 but < 150	7,909	65.2%	7,909	65.2%	3,160	26%
	≥150	396	3.3%	396	3.3%	8,305	68.4%
	Total	**12,137**	**100%**	**12,137**	**100%**	**12,137**	**100%**

Horizontal - Canopy Cover

Canopy cover effects are the same as described above in Alternative A. Table 46 displays the acres of canopy cover class by Alternative B and the No Action Alternative by time period.

Table 46: Alternative B - Acres of Canopy Cover Class by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Alternative	Canopy Cover	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
B	<10%	0	0.0%	958	7.9%	+7.9	0	0.0%	0.0%
	10-24.9%	2,367	19.5%	3,441	28.3%	+8.8%	660	5.4%	-14.1%
	25-39.9%	4,888	40.3%	4,625	38.1%	-2.2%	3,938	32.5%	-7.8%
	40-59.9%	4,365	36.0%	2,802	23.1%	-12.9%	5,111	42.1%	+6.1%
	60% plus	517	4.2%	311	2.6%	-1.6%	2,428	20.0%	+15.8%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	
No Action	10-24.9%	2,368	19.5%	2,368	19.5%	0.0%	592	4.9%	-14.6%
	25-39.9%	4,888	40.3%	4,888	40.3%	0.0%	3,000	24.7%	-15.6%
	40-59.9%	4,364	36.0%	4,364	36%	0.0%	4,975	41.0%	+5.0%
	60% plus	517	4.2%	517	4.2%	0.0%	3,570	29.4%	+25.2%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	

Post treatment (2021) Alternative B has 25.7% in 40% plus canopy and by 2041, 62.1% of project forested acreage in 40% plus. The No Action has 40.2% in 2021 and 70.4% in a canopy cover greater than 40% by 2041. By 2041, Alternative B promotes 21.9% and the No Action 30.2% more forested acres with 40% plus canopy from the existing condition.

Vertical – Canopy Layers

Canopy layer effects are the same as discussed in Alternative A above. Table 47 displays the acres of canopy layer types by Alternative B and the No Action Alternative by time period. With treatments in Alternative B stands are less dominated by continuous canopy layers post treatment and through 2041. Post treatment 65.4% of the acres will have 3 or more canopy layers and by 2041, 69.1% will exhibit 3 or more layers (Table 47). In comparison, under the No Action Alternative, 97.3% in both 2021 and 2059

will have 3 or more canopy layers (Table 47). Additional disturbances beyond 2041 to remove new developing layers would need to occur to maintain less multi canopy conditions.

Table 47: Alternative B - Acres by Canopy Layers by Time Period and Percent Change

		Pre Treat - 2017		Post Treat - 2021			2041		
Alternative	Canopy Layers[1]	Acres	% Forested Area	Acres	% Forested Area	% Change 2019 - 2021	Acres	% Forested Area	% Change 2017 - 2041
B	1	390	3.2%	3,345	27.6%	+24.4%	143	1.2%	-2.0%
	2	0	0.0%	850	7.0%	+7.0%	3,606	29.7%	+29.7%
	3	0	0.0%	150	1.2%	+1.2%	552	4.5%	+4.5%
	Continuous	11,747	96.8%	7,792	64.2%	-32.6%	7,836	64.6%	-32.2%
	Sub Totals	**12,137**	**100%**		**100%**		**12,137**	**100%**	
No Action	1	332	2.7%	332	2.7%	0.0%	23	0.2%	-2.5%
	2	0	0.0%	0	0.0%	0.0%	309	2.5%	+2.5%
	3	0	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
	Continuous	11,805	97.3%	11,805	97.3%	0.0%	11,805	97.3%	0.0%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	

[1] Number denotes number of canopy layers. Continuous equals more than 3.

Forest Vegetation – Pine Beetle Hazard

Effects to beetle hazard in the forest vegetation are similar to those discussed above in Alternative A. The difference is a different set of treatment acres (Table 36). Alternative B reduces moderate/high beetle hazards to varying degrees. Pretreatment 8.3% of the treatment acreage is in high hazard, 90.3% is in moderate hazard. Implementation of Alternative B increases high hazard by 0.3%, moderate drops to 67.1%, and 24.3% is now in a low hazard. By 2041, high hazard is at 70.1%, moderate at 13.4% and the low is at 16.5%. In comparison the No Action has 8.8% in high hazard and 89.9% in moderate hazard in 2021. By 2041 high hazard is 93.7% and moderate is 6.1%. Table 48 below displays by Alternative B and the No Action Alternative the acres and percent of acres in each hazard and then compares the acres and percent change from existing conditions for post treatment and in 2041 (Sandbak, 2018I).

Table 48: Alternative B - Pine Beetle Hazard Rating by Time Period and Percent Change.

		Pre Treat - 2017		Post Treat - 2021			2041		
Alternative	Pine Beetle Hazard	Acres	% Forested Area	Acres	% Forested Area	% Change 2017 - 2021	Acres	% Forested Area	% Change 2017 - 2041
B	Low	166	1.4%	2,949	24.3%	+22.9%	1,995	16.5%	+15.1%
	Moderate	10,961	90.3%	8,138	67.1%	-23.2%	1,629	13.4%	-76.9%
	High	1,010	8.3%	1,050	8.6%	+0.3%	8,513	70.1%	+61.8%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	
No Action	Low	164	1.3%	192	1.6%	+0.3%	29	0.2%	-1.1%
	Moderate	10,910	89.9%	10,918	89.9%	0.0%	746	6.1%	-83.8%
	High	1,063	8.8%	1,027	8.5%	-0.3%	11,362	93.7%	+84.9%
	Sub Totals	**12,137**	**100%**	**12,137**	**100%**		**12,137**	**100%**	

Like Alternative A, Alternative B creates acres in a low hazard and reduces the amount of acres in the moderate and high hazard, most notably post treatment (Table 48). Alternative B when compared to the No Action Alternative there is a greater amount of change in hazard ratings through the 24 year time period. Compared to existing conditions (2017), low hazard rating increases by 22.9%, high hazard acreage increases by 0.3%, and moderate hazard decreases by 23.2% post treatment. Post treatment 8.6% occurs in high hazard. By 2041, in comparison to pretreatment conditions, low hazard increases by 15.1%, moderate decreases by 76.9% and high hazard increases by 61.8%. About eighty three to seventy six percent of the landscape could experience high amounts of mortality if an outbreak was to occur and weather conditions are conducive to the mountain pine beetle from 2021 to 2041 under Alternative B.

In comparison the No Action Alternative, hazard ratings continue to increase in the high hazard, with <2% hazard rating below moderate through the 24 year time period (Table 48). By 2041, moderate hazard decreases by about 84% with a corresponding increase in high hazard from pretreatment conditions.

Alternative B reduces the amount of acres that could experience large mortality if an outbreak of MPB were to occur over that in the No Action Alternative by maintaining a higher amount of acreage in low hazard over the post treatment time period (2021 to 2041). Compared to the No Action Alternative (from post treatment to 2041) 75.7 to 83.5% of Alternative B acres could experience a high amount of mortality if an outbreak were to occur, which is a 22.8% to 16.3% decrease from the No Action Alternative. Alternative B promotes about 16% less acres in mod/high than the No Action Alternative in 2041.

Conclusion

Like in Alternative A the percent change in forest composition and structure are a function of the amount of acres treated and forest succession over the 24 year period. Direct and indirect effects to forest vegetation structure and composition attributes are discussed in the above sections on the 4,493 treatment acres (cover type, size class, canopy cover and canopy layers) the cumulative effects at the project level changes in acres (~12,137 existing forested acres and ~240 existing non forested acres) are summarized below for changes in 2 time periods pretreatment to post treatment and pretreatment to 2041. Like Alternative A additional treatments or more aggressive treatments would need to occur to affect landscape level changes that would last longer. Summary tables are below (Table 49) and are available in the project record (Sandbak, 2018I).

Pretreatment (2017) to Post Treatment (2021):

- Cover Type – maintain existing ponderosa pine cover in the project area with a gain of 240 acres of forest cover in burned areas.
- Size Class – 7.9% gain in initiation of tree class size < .1” and gain of 12.0% in 15” plus size class; corresponding loss in the 5-9.9” and 10 -14.9” classes.
- Basal Area – 24.7% gain in acres with basal area less than 80 ft^2.
- Canopy Cover Class – 14.5% reduction in 40% and greater canopy cover and corresponding gain in less than 40%.
- Canopy Layer Class – 31.4% loss in 3 or more canopy layers with gain in 2 or less.

Pretreatment (2017) to 2041:

- Cover Type – maintain existing ponderosa pine cover in the project area with a gain of 240 acres of forest cover in burned areas.
- Size Class – 8.2% gain in tree class size .1 – 4.9" inch and gain of 11.1% in 15" plus size class; corresponding loss in the 5-9.9" and 10 -14.9" classes. Gains in small size class due to CTM (small openings) and REGEN ST treatments. Gains in large size class due to intermediate treatments (ICD and CTM) of thinning from below and promoting large trees.
- Basal Area – 22.2% gain in acres with basal area less than 80 ft^2.
- Canopy Cover Class – 21.9% gain in 40% and greater canopy cover and corresponding loss in less than 40%. Gains are due to continued stand development in the untreated areas and in the intermediate treatments.
- Canopy Layer Class – 27.7% loss in 3 or more canopy layers with gain in 2 or less.

Beetle Hazard

Cumulative effects from the proposed treatments at the project area (4,493 across 12,137 forested acres) on MPB hazards are small, because like the existing forest vegetation conditions in the treatment units the majority of acres are in a moderate and high hazard by 2041. Alternative B increases high by 0.3%, decreases moderate by 23.2% and gains 22.9% in low hazard from existing to post treatment (2021). By 2041 the cumulative effects from the Alternative B treatments and continued stand development increases high by 61.8%, decreases moderate by 76.9% and increases 15.1% in low hazard. In comparison, with the No Action Alternative existing hazard conditions are maintained in 2021. From 2017 to 2041 stand development under the No Action increases high hazard by 84.8% and reduces moderate and low hazard by that amount (Table 34). Table below summarizes changes in beetle hazard with implementation of Alternative B.

Assuming no large disturbances occur at the project level, treatment effects to forest vegetation has cumulative effects for beetle hazard as described above. The effectiveness of treatments is only realized in treated stands. Additional acres of treatments or more aggressive treatments (like REGEN ST, CTM small openings, and ICD) would need to occur to maintain treatment effects at reducing beetle hazard longer term at the project landscape.

Table 49: Resource Indicators and Measures for Alternative B – Cumulative Effects

Resource Element	Resource Indicator	Existing Acres	% Forested Area	Measure (% Change from Existing to Post Treatment)	Measure (% Change from Post Treatment to 2041)
Forested Vegetation Composition - Size Class[1]	<1"	0	0.0%	+7.9%	0.0%
	.1- 4.9"	21	0.2%	0.0%	+8.2%
	5 - 9.9"	653	5.4%	-0.7%	-0.3%
	10- 14.9"	11,296	93.1%	-19.2%	-19.0%
	15" Plus	167	1.4%	+12.0%	+11.1%
Forest Vegetation Structure – Horizontal (Basal Area per acre)1	< 80	467	3.8%	+24.7%	+22.2%
	≥ 80 and ≤ 120	3,355	27.7%	+3.1%	-22.9%
	>120 and < 150	7,865	64.8%	-25.1%	-36.3%
	≥150	450	3.7%	-2.7%	+37.0%
Forest Vegetation Structure – Horizontal (Canopy Cover)[1]	<10%	0	0.0%	+7.9	0.0%
	10-24.9%	2,367	19.5%	+8.8%	-14.1%
	25-39.9%	4,888	40.3%	-2.2%	-7.8%

Resource Element	Resource Indicator	Existing Acres	% Forested Area	Measure (% Change from Existing to Post Treatment)	Measure (% Change from Post Treatment to 2041)
	40-59.9%	4,365	36.0%	-12.9%	+6.1%
	60% plus	517	4.2%	-1.6%	+15.8%
Forest Vegetation Structure –Vertical (Canopy Layers)[1]	1	390	3.2%	+24.4%	-2.0%
	2	0	0.0%	+7.0%	+29.7%
	3	0	0.0%	+1.2%	+4.5%
	Continuous	11,747	96.8%	-32.6%	-32.2%
Forest Vegetation – Pine Beetle Hazard [1]	Low	166	1.4%	+22.9%	+15.1%
	Moderate	10,961	90.3%	-23.2%	-76.9%
	High	1,010	8.3%	+0.3%	+61.8%
Forest Vegetation – Planting[2]	Acres Planted	253	0.0%	+100%	+100%

[1]Acres and % change does not include the 240 acres of currently non forested planting acres.

[2]Acres includes fire areas that are not currently forested (240 acres).

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans and Other Disclosures

Implementation of the Action Alternatives is consistent with the Forest Plan goals, objectives, and management standards. See above for forest wide and individual management area goals and standards. Implementation of the No Action Alternative is not consistent with the Custer Forest Plan goals, objectives, and management standards for multiple use vegetation management as disclosed in Table 50 below.

Implementation of the proposed action alternatives is consistent with numerous other laws, regulations, and policies (Table 51). Disclosures are based on rationale for the action alternatives in the above forest vegetation discussion and in supporting documents for Forest Vegetation Report in the Project Record. Consistency of the No Action Alternative with numerous other laws, regulations, and policies is disclosed in Table 51. Disclosures are based on rationale for the No Action alternative in the above forest vegetation discussion and in analysis documents in the Project Record.

Table 50: Forest Plan Consistency for Alternatives

FP MA	Action Alternatives (A and B)	No Action Alternative.
B	Proposed forest management activities will perpetuate and enhance wildlife habitat values, maintain forest health, vigor, productivity and provide vegetative diversity for wildlife. Tree encroachment on traditional grassland areas will be reduced. Wood products will be provided to help maintain timber dependent communities.	No forest management activities proposed; forested areas would continue to grow with declines in wildlife habitat values if large disturbance (MPB or wildland fire) were to occur. No wood product removal. No opportunity to maintain forest health, vigor, productivity or provide vegetative diversity for wildlife. Risk to loss of the forest vegetation with continued fire suppression activities.
D	Proposed forest management activities will help maintain forest health, vigor, and productivity. Long term diversity and quality of habitat will have a higher probability to be maintained. Wood products will be provided to help maintain timber dependent communities.	No forest management activities proposed; forested areas would continue to grow with declines in forest health, vigor, and productivity. Long term diversity and quality of habitat is at risk with increased risk for large disturbances (low resiliency). No wood product removal.

FP MA	Action Alternatives (A and B)	No Action Alternative.
G	Proposed forest management activities will help maintain forest health, vigor, and productivity and provide vegetative diversity for wildlife. Implementation of proposed activities will assist in maintenance and improvement of a healthy diverse forest and vegetation diversity for wildlife. Wood products will be provided to help maintain timber dependent communities. Regeneration treatments are designed to favor natural regeneration.	No forest management activities proposed; forested areas would continue to grow with declines in forest health, vigor, and productivity. With wildfire suppression, a healthy diverse forest and vegetation diversity for wildlife is at risk. No wood product removal for timber dependent communities.
N	Limited proposed forest management activities will restore green ash dominated woody draws to improve wildlife habitat when these occur in proposed treatment areas. Ten percent of the ponderosa pine trees will be maintained with a preference to retain large trees with fire scars. Wood products will be provided with a purpose to restore (perpetuate) the values of the woody draw systems.	No forest management activities proposed; forested areas would continue to grow with declines in forest health, vigor, and productivity. With wildfire suppression, a healthy diverse forest and vegetation diversity for wildlife is at risk. No wood product removal for timber dependent communities. No woody draw restoration would occur.
P	Proposed forest management activities will help maintain forest health, vigor, and productivity and provide vegetative diversity for wildlife. Although not part of the timber base, wood products will be provided to help maintain timber dependent communities.	No forest management activities proposed; forested areas will continue to grow with declines in forest health, vigor, and productivity. Protection or maintenance of other values is at risk with increased risk for stand replacement disturbances.

Table 51: Other Required Disclosures for the Alternatives

Act, CFR, Forest Service Policy	Action Alternatives (A and B)	No Action Alternative
Organic Administration Act	Provides for a supply of timber for the use and necessities of citizens of the United States.	No supply of timber for the use and necessities of citizens of the United States. There is a risk of a stand replacement fire and MPB outbreak with the No Action Alternative that would severely limit the supply of timber from the GRLA area over the next 80 to 100 years.
Knutson-Vandenberg Act	Timber harvest is proposed that would allow collection of funds from the timber purchaser to protect and improve the future productivity of the renewable resources of the forestland.	No harvest proposed to collect funds to protect and improve the future productivity of the renewable resources of the forestland.
Anderson-Mansfield Reforestation and Revegetation Act	Proposed treatments on lands within project area would provide timber needs of local communities. There would be no denuded lands from proposed treatments within the project area.	No treatments are proposed on lands within project area capable of producing a part of the timber needs of local communities. There would be no planting of fire areas within the project area, these areas would remain unstocked for extended periods. There is a risk of stand replacement fire and MPB outbreak that would result in large areas needing reforested (denuded).
Granger-Thye Act	Timber harvest is proposed. Deposits from the timber purchaser would be secured to cover the cost of disposing of brush and other debris resulting from their cutting operations.	No harvest proposed.
Multiple-Use Sustained-Yield Act	National forests were established and are to be administered for many purposes one being timber. Multiple use means the management of all the various renewable	National forests were established and are to be administered for many purposes one being timber. Multiple use means the management of all the various renewable surface resources of the

Act, CFR, Forest Service Policy	Action Alternatives (A and B)	No Action Alternative
	surface resources of the national forest so they are utilized in the combination that would best meet the needs of the American people. Timber harvest is proposed to utilize the resource and provide timber products to the American people.	national forest so they are utilized in the combination that would best meet the needs of the American people. No timber management is proposed. There is a risk of stand replacement fire and MPB outbreak that would result in the loss of the timber resource for 80 to 100 years.
Forest and Rangeland Renewable Resources Planning Act	It is policy that all forested lands in the National Forest system be maintained in appropriate forest cover with the species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management. Desired conditions for the action alternatives maintain forest cover to meet the multiple standards, goals and objectives in the Forest Plan. All regeneration harvests and small openings created during prescribed fire implementation would be monitored (1st, 3rd, and 5th year) to ensure forest cover reestablishment per the stocking objectives stated in the design criteria above (Project Design Features, Mitigation, Monitoring Common to Action Alternatives) and monitoring item E2 in the Forest Plan (pg. 107).	It is policy that all forested lands in the National Forest system be maintained in appropriate forest cover with the species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management. No timber harvest is proposed. There is a risk for a stand replacement fire that would result in the loss of the timber resource in the Threemile area for 80 to 100 years, impacting the multiple use and sustained yield outputs in the forest plan. There will be no planting in fire areas. Due to lack of natural seed source a long period of non-forested conditions is expected.
National Forest Management Act	See Forest and Rangeland Renewable Resources Planning Act above. The action alternatives would provide for a diversity of vegetation conditions in the forest vegetation to meet multiple objectives in the Forest Plan overall goals and specific management area standards and objectives.	It is policy that all forested lands in the National Forest system be maintained in appropriate forest cover with the species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management. No forest management is proposed. There is a risk for a stand replacement fire and bark beetle outbreaks that would result in large areas of deforested land creating a backlog of reforestation needs. With no management the forested vegetation in the project area would continue to trend to homogeneous conditions barring any natural disturbances. The desired diversity of vegetation conditions in the project area to meet multiple objectives in the Forest Plan overall goals and specific management area standards and objectives would not be met if large natural disturbances occur.
Reforestation Trust Fund, Title III – Reforestation, Recreation Boating Safety and Facilities Improvement Act	Forest management activities are proposed that would be eligible to utilize trust fund dollars for reforestation, timber stand improvement, and other forest stand improvement activities to enhance forest health and reduce hazardous fuel loads of forest stands in the project area.	No forest management activities are proposed to utilize trust fund dollars for reforestation, timber stand improvement, and other forest stand improvement activities to enhance forest health and reduce hazardous fuel loads of forest stands in the project area.
Title 36 Code of Federal Regulations, Part 219 - Planning	The overall goal of managing the National Forest System is to sustain the multiple uses of its renewable resources in perpetuity while maintaining the long-term productivity of the land. Resources are to be managed so they are utilized in the combination that would best meet the needs of the American people. Maintaining	The overall goal of managing the National Forest System is to sustain the multiple uses of its renewable resources in perpetuity while maintaining the long-term productivity of the land. Resources are to be managed so they are utilized in the combination that would best meet the needs of the American people. Maintaining or restoring the health of the land enables the National Forest

Act, CFR, Forest Service Policy	Action Alternatives (A and B)	No Action Alternative
	or restoring the health of the land enables the National Forest System to provide a sustainable flow of uses, benefits, products, services, and visitor opportunities. The proposed action alternatives use timber harvest (with non-commercial post-harvest treatments), prescribed burning treatments, and areas of no treatments to create a diversity of vegetation condition and age classes in the project area to provide multiple uses to meet the Forest Plan overall goals and management area objectives and standards.	System to provide a sustainable flow of uses, benefits, products, services, and visitor opportunities. No timber products would be provided. There is a risk for a large stand replacement fire or bark beetle outbreak that would impact the flow of timber products from the project area for 80 to 100 years.
Forest Service Manual 2479.01, 2470.3.	Regeneration treatments (REGEN ST – Seed Tree and small openings in CTM – group selection) are proposed to be regenerated in 5 years with the minimum trees per acre and percent stocked area by suitability displayed above (Table 13 and USDA, 2006). All regeneration harvest units would be monitored 1st, 3rd, and 5th year after harvest (Forest Plan Monitoring Item E2, pg. 107) for adequate stocking. Action will be taken if minimum regeneration stocking objectives are not met. Time frames and stocking objectives would be documented in the detailed silvicultural prescription prior to implementation.	No harvest proposed
Forest Service Manual 2409.33, 2472.03	Failure of regeneration post treatment from livestock grazing has not been documented on the Custer National Forest. If livestock grazing appears to be a problem, grazing would be deferred until restocked and seedlings can withstand the grazing pressure.	No harvest proposed
Forest Service Manual 2478.03	Prior to implementation of any treatment on forested areas a detailed silvicultural prescription would be prepared detailing the methods, techniques, and timing of the activities to achieve the objectives in the action alternatives.	No harvest proposed
Forest Service Handbook 2417.1	No openings larger than 40 acres have been proposed.	No harvest proposed

Comparison of Alternatives

The current forested condition (predominately in the southern half) of the project area is relatively contiguous in terms of size, age, composition, and structure, all of which are moderate to high hazard for disturbances such as crown fire and a mountain pine beetle epidemic. The action alternative's best meet the purpose and need for action because they treat acres to obtain desired conditions versus treating no acres and maintaining existing conditions that do not meet desired. They create openings as described above, creating a new age class of ponderosa pine. And they treat acres with intermediate treatments altering stand structure to potentially reduce crown fire potential (see fuels report) and reduce the effects of a MPB outbreak if it were to occur. And they return forest cover (northern portion) in wildfires areas (planting).

In contrast to the No Action Alternative the proposed treatments in the action alternatives are designed to alter the existing condition to create areas that are less dominated by forest vegetation that are conducive to large disturbance event such as wildfires and widespread insect outbreaks that can result in socially undesirable results. The proposed treatments are intended to create more heterogeneous forest vegetation conditions that may reduce the potential of crown fires and the potential of large amounts of mortality if an MPB outbreak were to occur. The intent is not to fireproof or beetle proof the forest vegetation but to allow these disturbance agents to operate at a scale of disturbance that may be more acceptable socially and sustain portions of the forest vegetation when they do occur. Proposed treatments do this by altering forest composition (age and size class) and forest structure (horizontal - BA and canopy cover; and vertical – canopy layers) as described previously.

Comparison of the alternatives on the existing forested vegetation by the resource indicator and measure are in the Table 52 below and summarized as follows:

- **Forested Vegetation Composition – Size Class:** Existing condition of the forested vegetation is the same for all alternative's with the domination of 10-14.9" on 93% of the forested acreage, no <1" size class and 1.4% in the 15" plus. Post treatment the No Action remains the same and Alternative A initiates 6.3% of the acreage in <1" and adds 12.6% more in 15" plus than the existing condition. Alternative B promotes 7.9% in the <1" size class and 12.0% more in the 15"' plus. Alternative B promotes 1.6% more in the <1" class and slightly less (0.6%) in the 15" plus class than Alternative A. The No Action Alternative does not initiate a new age class.

  By 2041, the No Action remains the same as existing and Alternative A has 6.8% more in the .1-4.9" class and 11.7% more in the 15" plus category than the existing condition. Alternative B promotes 8.2% more in the .1-4.9" class and 11.1% more in the 15" plus category. Alternative B promotes 1.4% more in the .1-4.9" class and 0.6% less in the 15" plus class than Alternative A. Both Alternative A and B promote more acreage in the 15" plus class than the No Action Alternative.

- **Forest Vegetation Structure – Horizontal (Basal Area per acre):** Acreage in the basal area per acre ranges for existing condition across the alternatives is nearly the same. There is a slight increase in the lower and upper ranges due to the modification of treatment boundaries in Alternative B. Across the alternatives less than 4% of the existing forested acreage is less than 80 square feet of basal area per acre. About 68% of the acreage is greater than 120 square feet per acre. Post treatment Alternative A has 22.5% more acreage in the less than 80 category and a reduction of 28.1% in the greater than 120 category than the existing condition. Alternative B promotes 24.7% more < 80 BA and reduces 27.8 > 120 BA. Alternative B promotes 2.2% more acres < 80 BA and reduces 0.3% less acres in BA > 120 than Alternative A. Both action alternatives promote more acreage less than 80 square feet per acre than the No Action Alternative.

  By 2041, the No Action has 65.1% more acreage in the greater than 150 category and 1.8% less in the under 80 category than the existing condition. Alternative A promotes 20.5% more in the less than 80 category and 37.1% more in the greater than 150 category. Alternative B promotes 22.5% more under 80 and 37.0% in the greater than 150 category. Alternative B promotes more acres in the less than 80 category than Alternative A (1.7%) and about the same in the greater than 150 category. Both action alternatives promote more acreage less than 80 and about 28% less in the greater than 150 category than the No Action Alternative.

- **Forest Vegetation Structure – Horizontal (Canopy Cover):** Existing canopy cover across all alternatives is dominated by the 25-39.9% class with about 40% ≥ 40%. Post treatment Alternative A reduces by 13.1% in the ≥40% classes and increases by 14.4% in the less than 25% classes from existing conditions. Alternative B reduces by 14.5% in the ≥40% and increase 16.7% in the less than 25% classes. Alternative B reduces 1.4% more in the ≥40% and increases 2.3% more in <25% than Alternative A. Both Alternative A and Alternative B reduce more acreage ≥40% and increase more < 25% than the No Action Alternative.

  By 2041, the No Action Alternative has increased by 30.2% in the ≥40% classes with a decrease of 14.6% in the < 25% classes from existing conditions. Alternative A increases by 22.2% in the >40% and decreases by 14.1% in the <25% classes. Alternative B increases by 21.9% in the ≥40% and decreases the same as Alternative A in the <25% classes. Both action alternatives increase less acreage in the ≥40% classes and decrease about the same acreage in the <25% classes in comparison to the No Action Alternative from the existing condition.

- **Forest Vegetation Structure –Vertical (Canopy Layers):** Continuous canopy layers are dominated across all alternatives in existing forested conditions. About 3% of the acreages is in a single story condition. Post treatment Alternative A increases by 31.9% single and two story conditions and decrease by 33.6% in continuous canopies from existing conditions. Alternative B increases by 31.4% and decreases by 32.6% in continuous canopy condition. Alternative A increases by 0.5% more in single story and decreases 1.0% more in continuous canopy condition than Alternative B from existing condition. Both action alternatives decrease continuous canopy conditions while the No Action Alternative maintains about 97% in continuous canopy.

  By 2041, Alternative A increases 27.4% in single and two story and decreases 33.1% in the continuous story from existing condition. Alternative B increases by 27.7% in single and two story and decreases 32.2% in continuous. Alternative B increases single and two story 0.3% more than Alternative A and decreases continuous 0.9% less than Alternative A. Both action alternatives decrease continuous canopy from existing in comparison to the No Action Alternative which maintains about 97% of the existing continuous canopy.

- **Forest Vegetation – Pine Beetle Hazard:** All alternatives have about 99% of the existing forested acreage in moderate and high hazard. Post treatment the No Action Alternative stays about the same as existing. Alternative A decreases moderate/high hazard by 20.9% of the existing condition and moves it into low hazard. Alternative B decreases moderate/high hazard by 22.9% and moves it into low hazard. Alternative B results in 2% increase in more forested acreage in low hazard than in existing. Alternative A and B have less acreage (2,688 and 2,949 acres) that would not experience significant levels of mortality if beetles are present and weather conditions are favorable, in comparison to the No Action Alternative of 192 acres.

  By 2041, the No Action Alternative has decreased low hazard by 1.1% with an 84.8% increase in high hazard from existing conditions. Alternative A decreases moderate/high hazard by 12.7% with a corresponding increase in low hazard from the existing condition. Alternative B decreases moderate/high hazard by 15.1% with a corresponding increase in low hazard. Alternative B decreases moderate/high hazard and increases low hazard by 2.4% more than Alternative A from existing conditions. Alternative A and B have less acreage (1,700 and 1,995 acres) that would not experience significant levels of mortality if beetles are present and weather conditions are favorable, in comparison to the No Action Alternative of 29 acres.

- **Forest Vegetation – Planting:** Both Alternative A and B plant 253 acres in fire areas with a net increase in forest cover of 240 acres, in comparison to the No Action Alternative that does no planting.

Table 52: Resource Indicators and Measures for Alternatives

Resource Element	Indicator/Measure	Existing				Measure (% Change from Existing to Post Treatment 2021			Measure (% Change from Post Treatment to 2041		
		No Action and Alt A		Alt B							
		Acres	% Forested Acres	Acres	% Forested Acres	No Action	Alt A	Alt B	No Action	Alt A	Alt B
Forested Vegetation Composition - Size Class	<1"	0	0.0%	0	0.0%	0.0%	+6.3%	+7.9%	0.0%	0.0%	0.0%
	.1- 4.9"	21	0.2%	21	0.2%	0.0%	0.0%	0.0%	0.0%	+6.8%	+8.2%
	5 - 9.9"	653	5.4%	653	5.4%	0.0%	-0.8%	-0.7%	0.0%	-0.5%	-0.3%
	10- 14.9"	11,296	93.0%	11,296	93.0%	0.0%	-18.1%	-19.2%	0.0%	-18.0%	-19.0%
	15" Plus	167	1.4%	167	1.4%	0.0%	+12.6%	+12.0%	0.0%	+11.7%	+11.1%
Forest Vegetation Structure – Horizontal (Basal Area per acre)	< 80	391	3.2%	467	3.8%	0.0%	+22.5%	+24.7%	-1.8%	+20.5%	+22.2%
	> 80 ≤ 120	3,441	28.3%	3,355	27.7%	0.0%	+5.6%	+3.1%	-24.1%	-23.4%	-22.9%
	>120 ≤ 150	7,909	65.2%	7,865	64.8%	0.0%	-25.7%	-25.1%	-39.2%	-34.2%	-36.3%
	>150	396	3.3%	450	3.7%	0.0%	-2.4%	-2.7%	+65.1%	+37.1%	+37.0%
Forest Vegetation Structure – Horizontal (Canopy Cover)	<10%	0	0.0%	0	0.0%	0.0%	+6.4%	+7.9	0.0%	0.0%	0.0%
	10-24.9%	2,368	19.5%	2,367	19.5%	0.0%	+8.0%	+8.8%	-14.6%	-14.1%	-14.1%
	25-39.9%	4,888	40.3%	4,888	40.3%	0.0%	-1.3%	-2.2%	-15.6%	-8.1%	-7.8%
	40-59.9%	4,364	36.0%	4,365	36.0%	0.0%	-11.6%	-12.9%	+5.0%	+5.8%	+6.1%
	60% plus	517	4.2%	517	4.2%	0.0%	-1.5%	-1.6%	+25.2%	+16.4%	+15.8%
Forest Vegetation Structure – Vertical (Canopy Layers)	1	332	2.7%	390	3.2%	0.0%	+23.8%	+24.4%	-2.5%	-1.7%	-2.0%
	2	0	0.0%	0	0.0%	0.0%	+8.1%	+7.0%	+2.5%	+29.1%	+29.7%
	3	0	0.0%	0	0.0%	0.0%	+1.7%	+1.2%	0.0%	+5.7%	+4.5%
	Continuous	11,805	97.3%	11,747	96.8%	0.0%	-33.6%	-32.6%	0.0%	-33.1%	-32.2%
Forest Vegetation – Pine Beetle Hazard	Low	164	1.3%	166	1.4%	+0.3%	+20.9%	+22.9%	-1.1%	+12.7%	+15.1%
	Moderate	10,910	89.9%	10,961	90.3%	+0.1%	-20.4%	-23.2%	-83.7%	-76.2%	-76.9%
	High	1,063	8.8%	1,010	8.3%	-0.4%	-0.5%	+0.3%	+84.8%	+63.5%	+61.8%
Forest Vegetation - Planting	Acres Planted	0	NA	0	NA	0	253[1]	253[1]	253[1]	253[1]	253[1]

[1]Measure is acres planted.

Effects resulting from the intermediate commercial treatments (ICD and CTM), combined with the post-harvest non-commercial and woody draw restoration treatments (WD) will generally last 15 to 40 years. Regeneration treatments (REGEN ST, CTM small openings, and PLT) will have a longer temporal effect of greater than 40 years. Treatments that were designed to have no thinning but have prescribe fire applied generally remain in or return to pretreatment conditions (RXB PP and RXB PP) in 15 to 40 years.

Do the proposed treatments meet the purpose and need for action to promote ponderosa pine and restore the ponderosa pine ecosystem towards a more heterogeneous forested landscape with a diverse age, structure (including old growth), and patch size that are more resilient to natural disturbances?

Regeneration Treatments (REGEN ST and CTM small openings)

Table 53: Regeneration Treatments Creating a New Age Class and Acres by Alternative

Alternative	REGEN ST Acres	CTM Small Opening Acres	Total Acres
A	264	514	778
B	467	491	958
No Action	0	0	0

Regeneration treatments do the following to meet the purpose and need at the treatment level (treated acres):

- Alternative B has 180 more acres of regeneration treatments than Alternative A and 958 more than the No Action Alternative.
- Within treated units, regeneration treatments alter forest vegetation composition and structure to reduce hazards to large disturbances events (MPB outbreaks and crown fire) that may result in widespread tree mortality.
- Treatments remove the current susceptible host and create a new age and size class that reduce the amount of area susceptible to MPB at one time (Tables 15 and 37).
- Regeneration treatments reduce continuous canopy layers (ladder fuels) for wildfire to climb up into the canopy that could result in high mortality and maintain it in single story or two story in the 20 year post treatment period (Tables 18 and 40).
- High conifer canopy cover is reduced post treatment, but will eventually reestablish by 2041 unless additional stocking control is done in the newly developed cohort (Tables 17 and 39).
- The combination of high canopy cover (>40%) and continuous canopy layers are reduced for 20 years post treatment, reducing risk of crown fires.

Regeneration treatments contribute to the desired future condition by reducing beetle and fire hazard, increasing pattern diversity and increasing the mosaic of a different size class and age types of the forest vegetation. For Alternative A openings would be created on approximately 778 acres. The size of openings ranges from one-half acre to 21.2 acres in size. This is about 16% of the treated acres and 6% of the forested acres. REGEN ST would create 47 openings ranging from 1.2 to 21.2 acres across 264 acres. Sixty six percent of the 778 acres would be in multiple openings ranging from .5 to 4 acres in size in the CTM treatments. About 35% of the CTM acres would be in these openings. Alternative B would create openings on 958 acres ranging in size from .5 to 22.1 acres on about 21% of the treated acres and about 8% of the forested acres. REGEN ST would create 66 openings from 0.2 to 22.1 acres. Fifty one percent of the 958 acres would be on the CTM treatments ranging from .5 to 4 acres in size. About 35% of the CTM acres would be in these openings. Future regeneration treatments should be considered to increase the age classes in the project area to even further reduce the amount of area susceptible to MPB at one time. The action alternatives best meet the purpose and need based on acres treated vs. no acres treated under the No Action Alternative. Alternative B creates 180 more acres than Alternative A in a new age class and more openings.

Intermediate Treatments (Commercial treatments - ICD, CTM thinning areas and post-sale understory thinning and non-commercial RXB PP and RXB NF) and Woody Draw Restoration Treatments (WD)

Table 54: Intermediate Treatments and Acres by Alternative

Alternative	ICD Acres	CTM Thinning Acres	RXB PP Acres	RXB NF Acres	Total Acres
A	949	954	1,466	599	3,968
B	1,070	913	1,141	398	3,522
No Action	0	0	0		0

Alternative A treats 446 acres more than Alternative B. Intermediate treatments do the following to meet the purpose and need at the treatment level (treated acres):

- Improve tree vigor
    - Increase growing space around individual trees and reduces competition for water, light and nutrients improving tree and stand vigor decreasing potential for insect outbreaks and effects to storm damage.
    - Accelerate growth.
- Promote large trees at various densities (trees per acre)
    - Implementation of the Alternative A promotes large trees in the ponderosa pine cover type on 92.9% of the forested area and 86.7% of treatment acreage in various trees per acre densities due to thinning from below (Table 19). Alternative B promotes large trees on 91.4% of the forested area and 76.7% of the treatment acreage (Table 41). Alternative A promotes 1.5% more of the forested area and 10% more of the treated acres in large trees.
    - Post treatment densities range from 1 to 10, 6 to 10, 15 to 25, and >25 or existing condition (Table 19 and 41). Post treatment with Alternative A there is a gain of 12.6% in the 15" plus size classes on all the forested acres (Table 22) and about a 32.3% increase on the non-planted treated acres (Table 15). Alternative B gains 12% on all the forested acres (Table 44) and gains about a 32.8% on the non-planted treated acres (Table 37). Alternative B gains 0.6% less across all the forested acres and gains about .5% more on the intermediate treated acres. In comparison the No Action Alternative remains unchanged in 2021 (post treatment).
    - In addition individual large ponderosa pine in the woody draw restoration treatments are promoted when they are encountered in the treatment units.
- Reduces tree densities (horizontal structure, i.e. basal area and canopy cover) and continuous canopy layers/ladder fuels (vertical structure).
    - Post treatment Alternative A has a 22.5% increase in acreage having basal areas less than 80 ft^2 (Tables 23 and 27) and 13.1% reduction in acres having greater than 40% canopy cover (Tables 24 and 27) for the project area. On the treated acreage, there is an increase of about 57.4% of the less than 80 ft^2 acreage and 33.6% reduction in the $\geq$ 40% canopy (Table 21). About 71.5% of the increase in the basal area less than 80 ft^2 and 87.7% of the reductions in the canopy cover greater than 40% are a result of these intermediate treatments in Alternative A (Tables 16, 17, and 21). Alternative B has a 24.7% increase in acreage less than 80 ft^2 and 14.5% reduction in canopy greater than 40% post treatment (Tables 45, 46, and 49) for the project area. On the treated acreage, there is an increase of about 66.6% of the less than 80 ft^2 and 39.4% reduction in the $\geq$ 40% canopy (Table 43). About 68% of the increase in the basal area less than 80 ft^2 and 81.6% of the reductions in the canopy cover greater than 40% are a result of these intermediate treatments in Alternative B (Tables 38, 39, 45, and 46). Post treatment Alternative B

creates more acreage (+347) in less than 80 ft^2 (Tables 23 and 45) and less acreage (-171) in canopy cover greater than 40% Tables 24 and 46) than Alternative A.
    - Post treatment Alternative A will have approximately 33.6% reduction in acreage having continuous canopy layers (Table 25). Alternative B reduces acreage of continuous canopy layers by 32.6%; 1% less than Alternative A (Table 47). Intermediate treatments ICD and CTM have the greatest acre reductions in both Alternatives (Tables 18 and 40). In comparison the No Action maintains about 97% of acreage in continuous canopy (Tables 25 and 47).
    - Post treatment both action alternatives reduce the amount of treated acres with a combination of high canopy covers (> 40%) and continuous canopy layers/ladder fuel that may enable wildfire to climb up into the canopy resulting in crown fires and high mortality. Alternative B promotes more acres (+171) post treatment with canopy cover <40% (Tables 24 and 46) and more acres (+57) in continuous canopy cover (Tables 25 and 47) than Alternative A. The No Action maintains existing conditions.
- Promotes ponderosa pine.
    - Both action alternatives reestablish forest cover on past wildfire areas across approximately 240 acres.

Intermediate treatments contribute to the desired future condition (Threemile Restoration and Resiliency Project Environmental Assessment – Desired Conditin and Purpose and need for Action) by reducing fire hazard (see fuels section), altering existing non resilient vertical and horizontal structure in the ponderosa pine cover type, promoting large ponderosa pine trees, and restoring green ash cover types in the project area. ICO treatments of ICD, CTM, and REGEN ST have the biggest impact on horizontal and vertical structure due to heavier thinning (Tables 16, 17, 18, 38, 39, and 40). RXB PP and RXB NF treatments dependent on the attribute generally have less impact and/or are shorter lived due to the focus of treatment (Tables 14, 16, 17, 18, 38, 39, and 40). Alternative A treats approximately 4,579 acres in the existing forested setting and an additional 240 acres of forest reestablishment; Alternative B treats 4,493 acres and reestablishes 240 acres of forest cover. The action alternative's best meet the purpose and need based on acres treated vs. no acres treated under the No Action Alternative.

Predominant treatment acres are intermediate (83% for Alternative A and 78% Alternative B) and effects as indicated above last 15 to 40 years as demonstrated in Tables 16, 17, 18, 38, 39, and 40 at 20 years post treatment. From 2021 to 2041 trees continue to grow (expansion of crowns, understory development, increased basal area) and acres greater than 40% canopy cover increase, 3 or more canopy layers develop and acres in basal areas greater than 80 ft^2 increase. This continued development has a negative effect on resiliency to disturbances. Additional treatment (thinning and/or prescribed fire) would need to occur to maintain post treatment conditions.

Do the proposed treatments meet the purpose and need for action to provide wood products to contribute to employment and industry in local communities and help support the sustainable supply of timber from National Forest System lands?

Commercial Treatments (ICD, CTM and REGEN ST)

Approximately 2,681 acres in Alternative A and in Alternative B 2,941 acres will be treated commercially and provide for wood products to local industry (see economics section). Alternative B commercially treats 260 more acres than Alternative A. The No Action Alternative does not provide wood product, therefore does not meet the purpose and need for action.

Do the proposed treatments meet the purpose and need for action to lessen the potential spatial extent and intensity of disturbances (such as high mortality form beetles)?

Regeneration Treatments (REGEN ST and CTM Small Openings)

Alternative A treats 778 acres and Alternative B 958 acres (Tables 19 and 41). Alternative B treats 180 more acres. Regeneration treatments do the following to meet the purpose and need at the treatment level (treated acres):

- Regeneration harvest creates a new age class of trees, which is a longer term strategy to increase resiliency to MPB outbreaks.
    - By altering the largely homogenous existing structure and composition in the ponderosa pine cover type (largely on the southern portion and non-wildfire areas), portions of the landscape will not be susceptible at the same time. This will reduce effects of a MPB outbreak if it were to occur. This is demonstrated in photos 3.1.1 and 3.1.7.

For both action alternatives' regeneration treatments with residual seed trees (REGEN ST and CTM small openings) reduce the majority of the acres of mountain pine beetle hazard from moderate to low and maintains some high on these treated acres. High hazard on the retained seed trees and low (or no) hazard on the new age class), thus meeting the purpose and need for action (Tables 20 and 42). A strategy in the CTM treatments creates a mix of small and medium sized openings to establish a new age class (1/2 to 4 acres in size on approximately 35% of CTM acreage) 514 acres in Alternative A and 491 acres in Alternative B. The REGEN ST in addition creates 47 openings ranging in size from 1.2 to 21.2 acres in Alternative A and 66 openings ranging in size from 0.2 acres to 22.1 acres. The action alternative's best meets the purpose and need based on acres treated vs. no acres treated under the No Action Alternative.

Intermediate Treatment (ICD, CTM thin areas, RXB PP, RXB NF and WD)
Intermediate treatments do the following to meet the purpose and need at the treatment level (treated acres):

- Post treatment Alternative A increased low hazard by 20.9% and Alternative B increase it by 22.9% (Tables 26 and 48). On the treated acres post treatment, Alternative A increases low hazard by 52.9% and Alternative B by 61.8% from that in existing condition (Tables 21 and 43). About 69.1% of the increase in Alternative A and 65.5% in Alternative B is due to these intermediate treatments (Tables 20 and 42).
- The action alternatives reduce the amount of acres that could experience large mortality if an outbreak of MPB were to occur over that in the No Action Alternative. Alternative A increases low hazard by 12.7% and Alternative B increases it by 15.1% over that of existing low hazard for the post treatment time period from 2017 to 2041 (Tables 26 and 48). On the treated acres post treatment, Alternative A increases low hazard by 35.3% and Alternative B by 43.9% from that in existing condition (Tables 21 and 43). About 53.7% of the increase in low hazard acres on the treated acreage is due to intermediate treatments in Alternative A and 51.5% in Alternative B (Tables 20 and 42).
- RXB PP and RXB NF treatments do not reduce the MPB hazard rating less than a moderate on the treated acreage because the quality and quantity of the host (i.e. ponderosa pine > 8" DBH) is still present, and is therefore a less effective treatment compared to regeneration harvest and ICD treatments (Tables 20 and 42). CTM thinned treatment areas reduce MPB hazard to low post treatment, however with continued stand growth MPB hazard increases to moderate 20 years post

treatment. Retained clumps (CTM and ICD) and the heavier residual over story stocking in the RSXB PP and the RXB NF remain at moderate/high.

- Thinning ponderosa pine stands may reduce the effects if a MPB outbreak were to occur. This is demonstrated in photos 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, and 3.1.8.
    - Thinning from below optimizes the effects of microclimate and decreases the ability of the beetle from finding, selecting and colonizing the host.
    - Thinning increases growing space to enhance tree vigor of the residual trees, which strengthens insect resistance mechanisms making them less susceptible to attack/mortality.

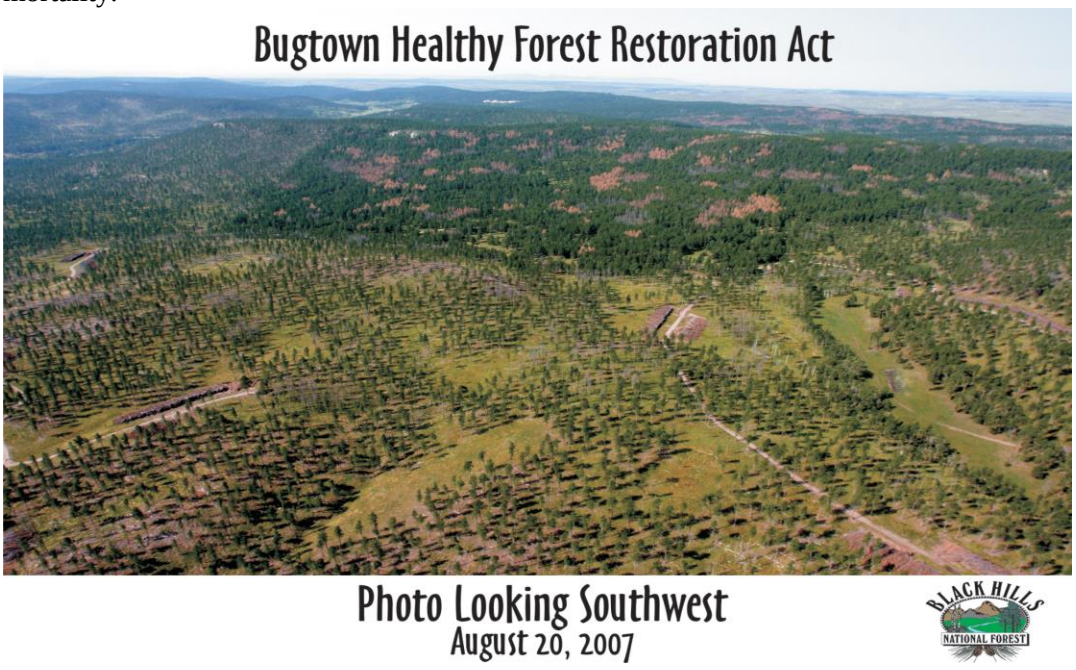
Even though intermediate treatments do not reduce the hazard rating totally to low hazard for MPB, it makes existing stands less vulnerable to attack, and therefore meets the purpose and need for action but not as well as regeneration treatments. ICO commercial thinning treatments (ICD and CTM) have the biggest impact on altering conditions due to heavier thinning post treatment. CTM with a lighter thinning 20 years post treatment returns all the thinning acres to moderate/high., whereas the ICD maintains low hazard on the non-clumped areas. RXB PP and RXB NF generally hold the existing beetle hazard post treatment and by 2041 majority of the acreage move into a high hazard (Tables 20 and 42). Alternative A commercially thins (ICD and CTM) ponderosa pine on about 1,903 acres (1,153 have prescribed fire) and applies prescribed fire only (RXB PP and RXB NF) to about 2,065 acres. Alternative B commercially thins (ICD and CTM) ponderosa pine (WD) on about 1,983 acres (1,040 acres have prescribed fire) and applies prescribed fire only (RXB PP and RXB NF) to about 1,539 acres. The 253 acres of PLT treatment will generally be in a no hazard due to size not being susceptible. The Action alternative's best meet the purpose and need based on acres treated vs. no acres treated under the No Action Alternative.

Examples of Treated and Untreated Forest Vegetation

Photo 1: Age-class diversity within lodgepole pine forested area on the Medicine Bow-Routt National Forest following regeneration treatments in Colorado. Severe MPB infestations occurred in mature lodgepole pines in mid-2000s while the younger pine cohort was resilient to MPBs and provided for resilience to multiple disturbances.

Photo by Brian E. Howell

Photo 2: Thinned ponderosa pine stands within the Bugtown project areas within the Black Hills National Forest in 2007. Thinned areas had minimal MPB-caused mortality and high residual vegetation survivorship after exposure to severe MPB infestations while unthinned areas had substantial tree mortality.



Photos 3 and 4: Thinned and unthinned ponderosa pine stands within the Jimtown project area on the Helena National Forest in Montana. Approximately 300 acres of ponderosa pine forests were thinned to residual 50 ft^2/acre of BA in 2007 and 2008. A severe MPB infestation occurred following treatment causing substantial mortality within the unthinned areas and minimal mortality within the treatment locations.

Photo by Nancy Sturdevant

Photos 5 and 6:

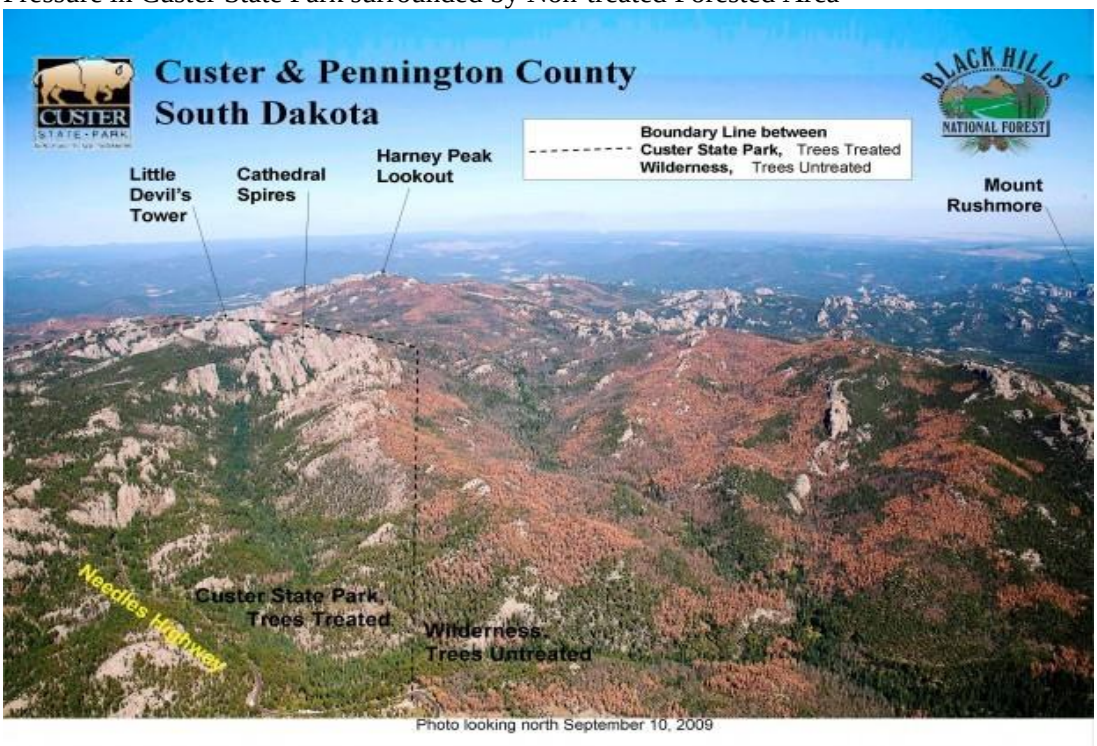
Demonstrate thinned lodgepole pine stands

resilience to a severe mountain pine beetle outbreak. These photos are associated with the Holland Pierce Fuels project on the Flathead National Forest in Western Montana. Photos are by Keith Konan.

Photo 7: Forest Resilience: Older Forest with no Age Diversity.

Photo from: Fraser Basin Council **http://www.shim.bc.ca/atlases/fbc/ss3/Forest.html**

Photo 8: Visual Representation of Resilient Thinned Ponderosa Pine Stands Challenged by High MPB Pressure in Custer State Park surrounded by Non-treated Forested Area



Note: Area depicted has similar dry-site climate and is approximately 225 miles southeast of Threemile Project Area. Thinning treatment enhanced inter tree spacing and reduced stocking levels to $\leq$ 60 feet^2 acre^{-1} of basal area

…….. ……
Your name and title **Date**

Glossary

Basal Area - The cross section **area** of the stem of a tree or of all trees in a stand, generally expressed as square units per unit **area (feet)**.

Conditional Crown Fire –Active: A type of crown fire in which the conditions required for sustained active crown fire are met but conditions required for crown fire initiation are not.

Mid/Late Seral – Shade tolerant species, that follow the early seral species in natural succession,

Passive Fire: A type of crown fire in which the crowns of individual trees or small groups of trees burn, but solid flaming in the canopy cannot be maintained except for short periods.

Quadratic Mean Diameter- A measure of average tree diameters square root of the arithmetic mean of the squared values.

Seral - A seral community (or sere) is an intermediate stage found in ecological succession in an ecosystem advancing towards its climax community

Stand Density Index – Stand density index (also known as Reineke's Stand Density Index after its founder) is a measure of the stocking of a stand of trees based on the number of trees per unit area and diameter at breast height of the tree of average basal area.

Surface Fire: Burn fuels at the ground surface (e.g. litter, shrubs, grasses).

VMAP - R1-VMap - Region 1 existing vegetation mapping products. Map Unit: The conceptual collection of map features with the same map label. A map feature is typically a member of numerous map units depending on the attribute of interest (e.g., dominance type, tree size class). A map unit is typically given a single label (such as PSME) but usually comprises a range of characteristics due to ecological complexity and mapping errors.

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